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Museums in Japan

SOICHIRO TSURUTA, MANAGING DIRECTOR, THE MUSEUMS ASSOCIATION OF JAPAN, AND DEPUTY DIRECTOR, NATIONAL PARK FOR NATURE STUDY, MINISTRY OF EDUCATION

In the present article, I intend to show the actual situation of museums in Japan, with emphasis on their educational activities. The most prominent effect given to museum activities in Japan's postwar years was by the promulgation of the Museum Law in 1951. It is therefore necessary to clarify the history of educational activities by referring to the museum activities centered around the law. Also, such terms as "educational activities" and "museum" have various connotations according to each nation, and I must clear up such points before approaching the main theme of this paper.

The end of World War II in 1945 was the turning point of various activities in Japan, and museums were not excepted. For example, in 1940, the number of museums in Japan, including facilities similar to museums, was two hundred and sixty. Immediately after the war, the number decreased to two hundred and thirty-one. Some museums faced financial hardships, and others underwent a change of management. Since then, however, the number of museums has grown rapidly, and by March, 1958, there were three hundred and seven new museums, and the total number was doubled as compared to prewar days. Now there are five hundred and thirty-eight museums in Japan. This rapid development since the end of the war brought forth a Museum Law in December, 1951, in response to the persistence of museum personnel and other people concerned with museums.

By this law, governmental assistance to museums was assured, and museum activities have witnessed steady progress. It should be noted that this law was passed in response to the concerted desire of the people con-

(EDITOR'S NOTE: Mr. Tsuruta is currently on a UNESCO fellowship to study museography in the United States and Europe.)

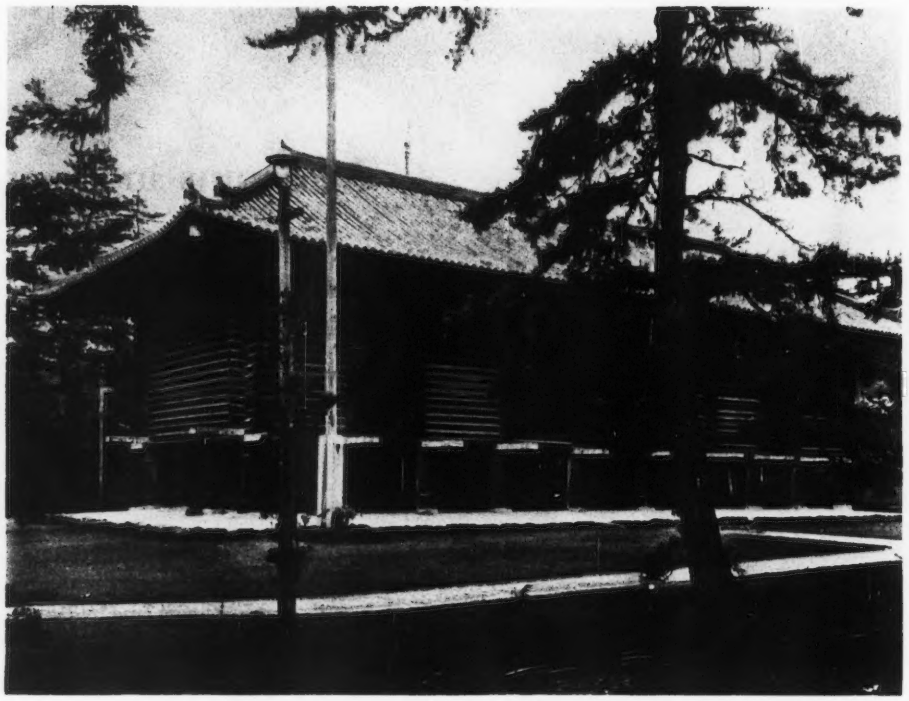

Fig. 1. Shosoin Museum, Kyoto, the oldest museum in Japan. In this storage building of the museum the most important national treasures are kept.

cerned and is an evidence that the government has now recognized the importance of museums. It was also exemplified by the fact that one hundred and forty-five new museums were opened during the six years between October, 1945, and November, 1951, and one hundred and fifty-two new museums were founded during the next six years between December, 1951, the month in which the law was promulgated, and March, 1958.

The Museum Law defined the concept of a museum, clarified its activities, and provided a common ground for the museum movement. Recognizing the importance of specialist personnel for better museum activities, the law provided for the recruitment and training of such personnel. Also, it made it possible for the government to grant funds to museums for improvement of their facilities, amounting to about 2,000,000 yen (about $5600) each year. The law also provided for the transportation of museum materials by the National Railway at a reduction of thirty per cent of the usual rate. The law also states that the Land Appropriation Act will not

apply to museums, so that they will be assured of holding their properties. The national tax is exempted or reduced on certain items as regards income tax, commodity tax, or customs; and the various local taxes will be exempted or reduced. Such provisions will not fail to foster the museum movement, as has been seen during the past seven years. Thus it may be said that a knowledge of the Museum Law is a prerequisite to an understanding of the museum movement in Japan.

Before the enactment of the Museum Law, the word "museum" was used in a narrower sense, and a zoo or an aquarium that kept living creatures or a temple or shrine that was a treasure repository was not a museum, but was called a "similar facility." Article 2 of the Museum Law defines museums broadly as "social educational facilities which aim at collecting, preserving, and exhibiting materials on history, art, folk life, industry, and natural science for the educational use of the general public, and the implementation of programs necessary for their culture, research, and recreation, as well as making researches in these materials." Facilities that have gone through the procedure provided for in the Museum Law will be called "registered facilities" or "equivalent facilities" and those that have not will be called "similar facilities."

That the Museum Law included in its definition of museums zoos and aquaria was an epoch-making event for the development of these facilities. Zoos increased from the prewar figure of ten to forty, and aquaria from eleven to sixty-one, while their former recreational character became that of social education. The number of visitors, too, increased in great measure: sixteen zoos reported attendance of 12,606,997 in 1954, and twenty-four zoos in 1957 had 16,839,880 visitors. Aquaria had a similar increase in attendance, from 2,096,450 for sixteen facilities in 1954 to 3,232,431 for eight aquaria reporting in 1957.

It is a general habit to divide the educational or popularizing function of a museum into "exhibition" and "educational activities." But as the purpose of this paper is not only to discuss educational activities but also to grasp the general situation of Japanese museums, I have tried to discuss various aspects of museum activities, including "temporary exhibition" which is one type of museum exhibition, so that the Japanese museums may be understood from the viewpoint of their activities.

The documentation for this paper is rather scanty, and much is based on personal conclusions. I employed materials published by the Japan Museums Association, our monthly museum magazine *Hakubutsukan Kenkyu* (*Museum Studies*), reports of all Japanese museum congresses, publications of the Japan Zoological Gardens and Aquaria Association, those of the Japan Botanical Gardens Association, materials published by each individual museum, and materials printed by the Ministry of Education and its bureaus.

Fig. 2

Fig. 3

Educational activities in Japanese museums may be divided into those held within the museum and those held outside the museum. A detailed study of educational activities shows that there has been a ten per cent increase in the activities within museums between 1945 and 1957. On the other hand, outside activities indicate that there is still room for future development. Also, the fact that outside activities are only thirty-four per cent of activities within museums means that Japanese museums have not yet fully shifted themselves from the period of "museums waiting for people" to "museums reaching people."

Educational activities within museums can be divided into those in which commentaries or guidance will be given to the exhibits and those of general and indirect character. According to 1957 figures, the ratio is two to one for the former, the former having chiefly been special exhibitions and the latter, meetings of ordinary visitors. As of 1955, the average number of personnel was 11.5 persons. Excluding those who have jobs in addition to their museum work, there are 8.5 persons working in museums full

Fig. 2. A class of boys and girls in a specially equipped train, being taught nature study while on their way to visit the Chichibu Museum of Natural History near Tokyo.

Fig. 3. Boys and girls, having arrived at the Nagatoro station on their way to the Chichibu Museum of Natural History, study a key map of the mountains of the area.

Fig. 4. Making an exhibit for one of the exhibition halls in the Chichibu Museum of Natural History.

time. Those who can be engaged in educational activities are 2.2 persons (curator 1.5 and assistant curator 0.7) per museum, excluding the director. As is clear from these figures, the usual method of instruction is by means of labels, and few museums give commentaries or guidance on exhibits in accordance with the educational background of the visitors. Therefore, few museums have a guide who can assist curators. One of the rare examples may be seen at Toba Aquarium in Mie Prefecture where twenty-eight well-educated girl guides conduct tours. At the National Park for Nature Study of the Ministry of Education four curators are giving conducted tours to groups of pupils.

Information offices, loudspeakers, indoor broadcasting devices, and audio-visual facilities for commentary and guidance are not yet well developed. But one step forward is attempted in various science museums by organizing "moving exhibitions." Interesting devices of this kind are seen at the Broadcasting Museum in Tokyo, the Hot Spring Science Museum in Hokkaido, and the Meteorological Museum in Tokyo with its planetarium. The Ueno Zoo in Tokyo produced a sixteen-millimeter film entitled "Artificial Incubation of Crane," which has been exhibited abroad.

Publications include production of catalogues, commentaries, photographs, and picture cards, and notable publications can be seen especially on the occasion of special exhibitions. Such publications are chiefly pro-

Fig. 4

duced by art museums, while natural science museums produce fewer publications, even for special exhibitions. The contents of such publications have been improved very much, and paper of fine quality and the highest techniques of printing have been employed. The commentaries are easy to understand, and the compilation is so arranged that the contents depend more on pictures than on letters. The Leisure Center Science Room, run by the city of Sendai, recently put out a collection of lectures on natural scientific experiments for elementary and lower secondary school pupils of the city. Increasing numbers of museums are making films and slides using exhibits and distributing them for the purpose of popularization.

Temporary exhibitions are organized by Japanese museums at a rate of five times a year per one museum. Such exhibitions include the ones on the Louvre (1956) or Iran (1958) sponsored by the Tokyo National Museum which borrowed exhibition materials from foreign museums or collectors. Such exhibitions may be on view for several months, while photographic or poster exhibitions may last only several days. Some museums organize a temporary exhibition by rearranging their own collections according to a specially selected theme. Some borrow materials from other museums for a special exhibition. The museums keep up with current developments, as shown in the artificial satellite exhibit of the Tottori Prefectural Science Museum and the special Atomic Energy Room built by the Sagamiko Electric Science Museum. Temporary exhibitions have influenced the attitude of the visitors. In the case of an art exhibition which has first-class art objects such as national treasures or those of worldwide fame, there are surprisingly great numbers of visitors. Fewer people visit exhibitions of second-class art objects or reproductions.

With reference to the above phenomenon, it cannot be said that the ability of appreciation of the visitors has so increased in recent years as to lead to such attendance. Such a tendency was seen before and has become very noticeable during the past two or three years. This creates problems. For example, there are about a hundred art museums in Japan, and if all try to exhibit only first-class national treasures, there may be some museums that cannot have materials to display. For the number of national treasures does not increase rapidly. One may conclude that the number of old art museums in Japan is at saturation point and cannot increase in the future.

At any rate, temporary exhibitions are one of the most substantial activities of Japanese museums. The way of display has now become stabilized, judging from the space and materials, and it is expected that no rapid change (improvement or decline) will take place. It can be said that the pattern of such exhibition has now been formed.

Meetings for better understanding of exhibited materials of both perma-

Fig. 5. The Tokyo National Museum (art and history).

Fig. 6. National Science Museum, Tokyo.

Fig. 7. Tokyo Science Museum, Department of Geology.

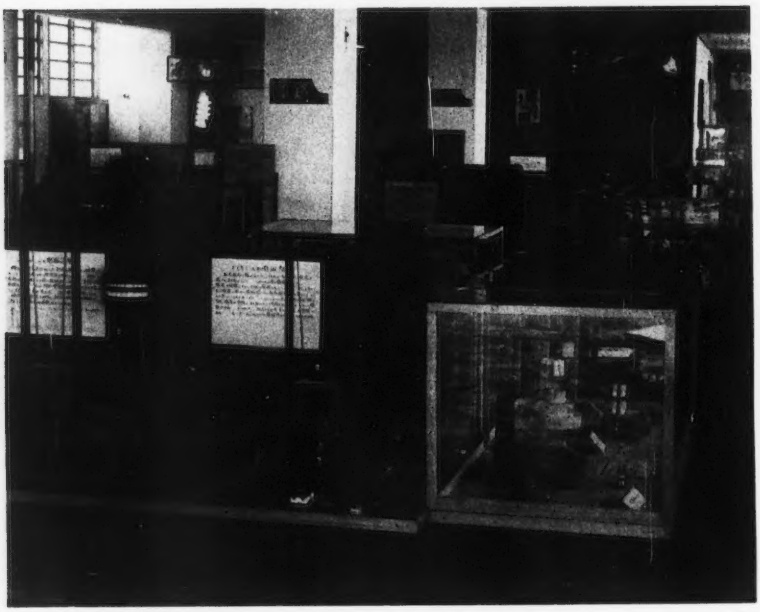

Fig. 8. Tokyo Science Museum, Department of Technology.

nent and temporary exhibitions are not many. Though the museums prepare various labels and give careful consideration to the display, there is some doubt that various kinds of visitors can have better understanding or appreciation. Therefore, there occurs a need for knowing how effective the display is and how the labels are read and understood by the visitors. And the meeting of visitors is one of the most effective methods of fulfilling the above need. There are many labels which are too difficult to understand, too long to read, too small in size, or which are not placed in the proper spot. It is supposed that there are many people who will never visit a museum again because they have once been disappointed by a museum. These facts must be studied in detail for future improvement.

Lectures or meetings of film-showing and explanation or round-table discussions are planned for temporary exhibitions. They are still fewer in number but are gradually tending to increase. For example, the Kyoto National Museum organizes several lectures on exhibits for each of its temporary exhibitions. At some museums curators guide visitors among the displays. Such attempts are usually made by well-founded museums with rich collections and enough research. This fact means that many of the Japanese museums are halfway towards such attempts.

General educational activities in the form of meetings at museums show a decrease because lecture meetings were the easiest method for museums under economic difficulties and lack of materials immediately after the war, as such meetings could be organized if the museum had enough room and a little money for a lecturer. The growth of citizens' halls, libraries, and schools with good rooms and facilities has taken the non-related lecture out of the museum, and the museum now must change its theme to one directly related to the materials it possesses. In a sense, the museum has a special field of activity as it can have a combination of materials and persons at its disposal. Visitors are no longer satisfied with seeing only permanent or temporary exhibitions but try to use the special qualities of museums for their own study and understanding. Thus, visitors ask for better equipment, open classrooms, research rooms, workshops, or experimental laboratories, and this, in my own view, has resulted in the rapid increase of such educational activities as the throwing-open of facilities and the guidance for visitors. Other activities include invitations to contests and competitions, which may be interpreted as a proper museum activity in that it unites materials owned by the museum to events related to local communities.

Although the same persons in many Japanese museums must be engaged in research and in educational activities at the same time, there are many effective and substantial educational activities. Research rooms, reference documentation rooms, workshops, technical rooms, public science rooms, and other special rooms for the public are being developed, although they

are not advanced more than the stage of experiment. Nevertheless, these can be looked for in the future in the field of educational activities.

The Japanese people are gathering more and more to technical training courses, experimental studies, art study meetings, or archeological study meetings, all of which are realized by mobilizing fully the materials, facilities, and techniques of museums. These meetings may be classified as follows: councils, study meetings, round-table discussions, and conferences concerning museum activities; report meetings, usually made by students upon the use of museum materials and facilities; lecture meetings, training courses, seminars, cultural room, summer "universities," guidance courses, and so on; technical training courses or experimental workshops for the training of museum workers; films, slides, television, radio, picture stories, marionettes, and drama meetings, depending on direct audio-visual aids.

I would like to expand my comments on one activity—that of the taste group. There are many meetings that are held according to taste, such as reading club, music circle, record concert, *raku-yaki* group (earthenware), fairy-tale club, elocution society, and even food-crank group. Such taste groups are especially necessary for Japanese museums, because they can make their members give easily and with much interest to the museum collections. Some say that science museums are much too rigid and hard for visitors to understand because of their scholastic attitude. Art museums, they say, are much too highbrow and too difficult for some people to appreciate, and archeological museums are too old and too far removed from our actual life. It is a general tendency of Japanese museums that they are not good at "giving life to science." Zoos in Japan, however, whether because of the attractiveness of the living animals or the interesting and sometimes funny meetings they have, reach as many as twenty million visitors a year, more than one-half of all the visitors to all the museums in Japan.

Another phase of museum activity is that of the contest or competition. Such competitions deal with paintings, compositions, or models. An example is the open competition for the protection of wild birds, jointly sponsored by the Ministry of Education and the Ministry of Agriculture, carried out by the National Park for Nature Study, inviting all the children of the elementary and lower secondary grades. The competition has two aspects—the entry of nest box for wild birds and the observation report written by recording the actual observation of the nesting at these boxes by wild birds. Competition is on such a large scale that it must extend for two years. It produces good results in promoting scientific knowledge and interest of school children by means of nature observation, and it contributes to emotional education by causing children to love nature. There are many contests or competitions, but this is the largest.

Fig. 9. From the NHK Broadcasting Building, which stands on a hill named Atagoyama in Minato-ku, Tokyo, the first beam of our regular broadcasts was sent out July 12, 1925. The museum was established in this building in commemoration of the thirtieth anniversary of radio service in Japan and was first opened March 3, 1956. Numerous data of historical value representing every stage of the development of broadcasting are exhibited, as well as various kinds of apparatus used for experimental purposes.

Commemorative events or annual events are also useful and instructive activities. Important events are marked by museums, sometimes with special benefit to them. Take the Matsumoto Municipal Museum's story. Men and children visited it, but few women came to see it. The Director felt that it was perhaps because the museum had a forbidding atmosphere. So he utilized the *Hinamatsuri* Week (Festival of Dolls) and included such events as attractive shows and displays that women visitors would like. The result was that the women felt that the museum had become an interesting place, and since then the Municipal Museum has been visited by women in ever-increasing numbers. Other museums take pains to observe festive occasions and holidays, as for example, on the fifth of May, the boys' holiday, when paper or cloth carps are hoisted as a sign of manliness; events connected with the *tanabata* (festival of the star Vega); the moon festival on the fifteenth of August; and many other events connected closely with the emotional life of the people—all are used by each museum in an attempt to have a good display using its characteristic collection.

Extramural educational activities include the use of traveling exhibitions, loans of material, and guided visits or tours by museum specialists. The Tottori Prefectural Science Museum first had a bicycle-drawn trailer,

later an auto-tricycle, for its traveling materials which were exhibited at a village hall or school auditorium so that the museum could combine display and lecture or discussion meeting.

Recently, many department stores have been organizing special exhibitions (mainly on art) to lure more people into their stores. As I stated before, people flock to first-class art displays, so the department stores try to put national treasures on display. Consequently, there are shrines, temples, and museums that lend their collections to city stores, but visitors cannot see them when they visit the places where the collections are supposed to be.

Many museums lend their materials to schools, while the National Museum for Safety in Industry is lending its materials to factories and business firms. People borrow materials from the Clothing Museum which is part of the Sugino Junior College in Tokyo.

Loans are done well, but no museum thinks that the loan is one of its major tasks, so will not prepare materials expressly for lending, such as a lending set for a school curriculum. This problem must be studied in the future.

Some museums, particularly the Tottori Science Museum and the Matsumoto Municipal Museum, send members of their staffs to speak to community youth in public halls or to make a series of lectures at various community centers of their respective regions.

Other types of meetings include the meeting for collecting materials on geology, zoology, and botany; on-the-spot archeological study meetings; summer schools; and winter mountain classes. Also there are inspection tours to factories, firms, historically famous places and scenic sites, and fishing excursions.

With the museum program in its infancy, but growing rapidly, there are also many problems. The first, What should be the educational functions of museums in Japan? What should the minimum standards as well as the most desirable standards be for museum activities? The Japan Museums Association submitted to the Ministry of Education its observation on the minimum standards of museum activity in connection with materials, technicians, buildings, sites, and the number of days to be opened to the public. In view of the variety of the nature of museums it is not an easy task to figure out minimum or maximum standards. Moreover, museum activities cannot be properly evaluated without considering their educational functions. When standards are established, the functions of museums will change from a storehouse function to that of becoming a living center of educational activities.

It is a common practice of museums in Japan to operate according to their experiences rather than according to the methods based on scientific and systematic surveys. Sometimes the activities of a museum may have

Fig. 10. Part of a showroom at the NHK Broadcasting Museum.

Fig. 11. Part of a showroom at the NHK Broadcasting Museum.

nothing to do with the need of the community in which it exists. Another trend often seen in Japanese museums is that they concern themselves more with the number of visitors than they do with education and program. This is one of the reasons that they neglect permanent collections in favor of temporary exhibits and set the target of their program activities on people outside the immediate community who visit as tourists. I have no objection to tourists, but the primary activity of the museum should be a close connection with its community.

Another problem is that of increasing museum-school relations. More than half of our museum visitors are school children and students, but there are not many museums that hold within their programs certain educational activities in close and systematic arrangements with the community schools.

The distribution ratio of museums by population in Japan is one museum for every 200,000 persons. Moreover, the larger number of museums is concentrated within a few urban districts, such as Tokyo, Osaka, Fukuoka, and other cities, while there are fewer than twenty museums established in such a large area as Hokkaido.

We are also concerned with the mutual relations of museums and can point out three types of interrelationships. In some regions or districts, museums are scattered without close mutual relationships. In other places, they are influencing one another in their activities. In still other instances there are regions where they are completely closed to one another. Most of the Japanese museums belong to the first grouping, and consequently there is less ground for mutual cooperation or for competition for better activities. This makes the work of the Japan Museums Association particularly difficult, but there are several liaison councils of museums that have been established at the prefectural level to coordinate the work of museums within the prefecture, as well as to maintain liaison among other prefectural councils of museums.

One of the most urgent problems confronted by museums in Japan (and I understand that it is also a pressing American problem) is that of securing and training museum staff. In Japan it involves not only securing and training but the question of better treatment of the museum staff who are less protected by the authorities than are those of any other similar professional group. We are trying to set up the school teachers as the example, who are covered by the Special Law for the Educational Civil Servants. In Japan there are eleven universities that provide training courses in museology. In-service training has not yet been provided.

The question of how to improve the present Museum Law now arises in order to solve many of our problems. There is no easy way for us to go. The first and continuous effort for us to make is to collect at a national level factual material on the practice of museums based on scientific

survey. The weakest point of our museum activities lies perhaps in the very attitude of the museums themselves, in that they neglect, in the name of ill treatment and lack of funds, the fundamental studies and self criticism based on scientific observation from which is to be derived every future possibility of museum improvement and activity.

Summing up, I feel that although many of our problems are restricted to Japan, the basic problems of museums have no nationality and no geography and that they are common to all museums in every part of the world.

A Museum Exhibit Interprets Basic Research. Why?

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THE AMERICAN MUSEUM OF NATURAL HISTORY, AND
RESEARCH ASSISTANT PROFESSOR OF ANATOMY
ALBERT EINSTEIN COLLEGE OF MEDICINE

Several months ago a new exhibit dealing with shrimps, lobsters, and crabs was opened to the public at The American Museum of Natural History. In this exhibit the life cycles of five decapod crustaceans commonly used as sea food are portrayed. Again and again the word "molting" appears in the labels, for one cannot discuss life cycles without implicating growth, and a decapod crustacean cannot grow without periodically shedding its shell, or molting. The exhibit points out that a "soft-shelled" crab is not a distinct species but merely a crab that has just molted and has not yet hardened its new shell. Yet if the exhibit had stopped there, a unique opportunity would have been lost—an opportunity to introduce to the public an exciting phase of current biological research, that of the neurohormonal control of growth. Decapod crustaceans, particularly crabs, are a focal point for certain aspects of basic research in this field.

Our exhibit goes on, then, to describe research in a subtropical land crab that shows how growth and molting are controlled. It depicts a land crab hidden away in its burrow and thus protected by darkness, solitude, adequate moisture, and favorable temperatures from the threat of death at its approaching molt. The labels explain that if this crab were to leave its burrow and molt on the exposed surface of the ground, it would have no defense against predators, desiccation, overheating, or chilling, and it would quickly perish. Molting must occur when a crab is safely concealed in its burrow if the crab is to survive. But how is such

precise timing accomplished? The central nervous system in this land crab has certain nerve cells called "neurosecretory cells" which can synthesize and release a chemical substance capable of inhibiting growth. Apparently when environmental factors are unfavorable to survival at molt, that is, when the environment is light, very hot, very cold, or very dry, or when other crabs are around, this information is channeled into the crab's central nervous system and its neurosecretory cells release into the blood stream a molt-inhibiting hormone. All growth processes cease at once. As soon as the environment becomes favorable, as is the case in the interior of the burrow, this information is relayed to the central nervous system of the crab, the neurosecretory cells withhold the molt-inhibiting hormone from the blood stream, growth processes start once again, and molting soon takes place.

Actual photographs of a molting land crab appear in the exhibit, this molt having been induced surgically by the removal of the crab's eyestalks under anesthesia. The neurosecretory cells that synthesize and release molt-inhibiting hormone are located largely within the stalked eyes of the crab. When the eyestalks are removed, there is no longer any way in which the crab can release this hormone into its circulation, and thus molting inevitably follows.

Lastly, in this exhibit the point is made that implications of such research may extend well beyond the land crab to the study of abnormal behavior and mental disease in human beings. Scientists now are aware that nerve cells within our brain synthesize and release various chemical substances and that aberrant mental states may be related in some instances to abnormal concentrations of some of these substances. Three decades of research on a variety of living forms by investigators studying the chemical substances produced and released by nerve cells have shown that the nervous system is not merely a complex network of cables with its all-important sign that of recordable electrical activity. It is also an actively secreting system, constantly synthesizing and releasing chemical agents, some of which are concerned with the transmission of nerve impulses from one nerve fiber to the next nerve fiber or to a muscle or a gland, while others have far-reaching metabolic effects. Lower animals

continued on page 216

Fig. 1. General view of exhibit showing a land crab in its burrow where environmental conditions favor molting. Colored transparencies illustrate process of molting. Labels explain the hypothetical mode of action of the crab's central nervous system in the control of growth and suggest that this type of basic research may have important implications in the study of abnormal behavior and mental disease.

Fig. 1

I AND SURVIVAL
te research

play important roles in the elucidation of the nature and action of neuro-endocrine substances, for research on the nervous system as a glandular organ in any living form, even a crab, may by analogy yield valuable insight into normal and abnormal nerve function in higher animals, including man.

Certain medical schools clearly recognize the value of a comparative approach to medical research. For example, the Department of Anatomy at the Albert Einstein College of Medicine includes specialists in the anatomy and physiology of insects, worms, amphibians, and lower mammals. Also on its roster are practicing neurosurgeons and, of course, experts in human anatomy. It is difficult to describe the stimulation that participating scientists may experience and the revelation that may result from discussion of, for instance, the neuro-endocrine control of growth in such diverse forms as human beings, white mice, toads, cockroaches, and crabs. Certain biological problems are comparable, and their solutions may also be comparable.

In the exhibit on shrimps, lobsters, and crabs at the American Museum of Natural History, an attempt has been made to carry the museum visitor well into the realm of basic research, with the hope that he may gain some understanding of how work on a form as far removed from man as a crab may be rewarding and in the long run extremely practical.

I recall a talk with an acquaintance one day not too long ago, during which I told him of my research on the neuro-endocrine system of crabs. His response was, "But why are you doing this?" This question is asked frequently of investigators doing basic research on lower forms of life. A medical researcher is not so often requested to explain his reasons for his choice of animal and of research problem, for the public is relatively well informed regarding the aims and methods of medical research, with its use of dogs, cats, guinea pigs, monkeys, and other higher animals as experimental forms. Wide coverage by press, radio, and television seems to have convinced the layman that techniques and theories in medicine require preliminary testing on other mammals before being applied to human beings. However, it has not always been made clear to him that significant and dramatic advances in the medical field may be and often must be preceded by considerable unpublicized work on living forms that are biologically much simpler than rats, guinea pigs, dogs, and human beings. In this respect a natural history museum can make an important contribution, by presenting in its exhibits various aspects of current research on lower animals and by explaining to the museum visitor the "practical" significance of such research.

A natural history museum is also accomplishing an important educational task whenever it informs its visitors of the ways in which "practical" research may come about. It is important for the layman to realize that,

when an investigator selects a comparatively simple lower animal on which to do research, he may wish merely to learn more about the animal just because it exists and he has a healthy scientific curiosity about it. As a by-product of his experimentation aimed at truth for its own sake, he may make discoveries of importance to medicine, agriculture, or other fields of applied science. Research of this type may prove to be just as "practical" as that undertaken with more specific objectives in mind.

On the other hand, a research worker may seek through skillful experimentation to "ask" a selected animal certain basic questions, the answers to which may shed light on unsolved problems in biology and medicine—problems that in many cases cannot be solved by work with higher animals because of the inherent complexity of such animals. Thus, from a study of tumors in insects may come information regarding the chemistry and physiology of abnormal cells that may be applicable at some future time to the study of mammalian cancers. Or, from observation of the daily rhythmicities of single-celled animals may emerge new understanding of innate biological rhythms and possibly new insight into persistent rhythms of man and other mammals. Whether the investigator succeeds in his task and does gain increased understanding depends upon many factors, but his work is of practical value nevertheless, for its aims are practical. No one can say in advance whether a given research project will meet with success or not. The very nature of research precludes any such prophecy. It has been said that doing basic research is a little like shooting at a target when one is not sure where the target is and in fact not even sure that there is a target. The layman would do well to keep this in mind when he judges the worth of scientific research projects. Practical benefits may accrue from research undertaken for "non-practical" reasons, and research aimed at practical ends may fail. Both types of research should be supported.

If a natural history museum can succeed in interpreting basic research to the layman, and if in addition it can convey an understanding of the need for supporting both "practical" and what superficially appears to be "non-practical" research, it may be able to credit itself with a third accomplishment, that of having furthered the essential cause of adequate financial support for scientific research. A public that recognizes the value of basic scientific research is probably a public that is ready and willing to support it. Such research in this mid-twentieth century is expensive. It costs more money than most privately endowed institutions can afford. The balance of its financial support must come from the government through the medium of such agencies as the National Science Foundation and the National Institutes of Health or from private organizations such as the American Cancer Society. The government can make available the needed funds only if the public is willing to provide them

by paying in taxes, cheerfully or otherwise, amounts adequate for the support of basic research. Private organizations can offer aid only if the public gives whatever it can afford to give whenever it can afford to give it. By doing its part to convince the public that basic scientific research is worthy of its support, a natural history museum is also doing its share of fund raising for science.

A research scientist working in a natural history museum can play a unique role in contributing to the mutual understanding between scientists and layman that is so sorely needed, for a museum scientist sits on both sides of the fence. He is the research scientist in need of public interpretation, and he is also the public interpreter. Museum and museum scientist together can further public appreciation of basic research in these critical days.

II/3 1959

A Sixteenth Century Terra Cotta Statue: Problems of Restoration and Preservation

JOSEPH TERNBACH

The restoration of a polychromed terra cotta statue, in the collection of the Detroit Institute of Arts, representing St. John the Baptist, fifty-five inches high, attributed to Giovanni Minelli,[1] presented difficult and challenging problems. Although the condition of the statue when it was received indicated the need for cleaning, extensive repairs, and preservative measures, it was only in the process of the work that the true nature of the statue's condition and the problems ahead became clear. That a large-scale restoration had been done at an earlier period[2] came to light in the process of my work. This restoration was poorly done, so that continuous internal damage and deterioration of the statue were inevitable.

STATUS AND CONDITION OF STATUE ON ARRIVAL FOR REPAIRS

The statue was mounted on a wooden base with attached backboard more than one and one-sixteenth inches thick. The board covered the whole of the back up to the base of the neck, so that only the neck and head were standing free (Fig. 1). The side borders of the board were covered with a cement that blended into the modeling of the sheepskin of the original statue itself. The bottom plate, while discernible, was painted and camouflaged to seem to be part of the terra cotta. There were numerous significant breakages and marks of breakages or cracks in the statue: a crack on the front of the neck; two cracks on the chest running from the neck towards the waist. The right arm was broken below the shoulder;

[1] Planiscig, L., *Venezianische Bildhauer der Renaissance*, Vienna, 1921, pp. 155 ff.
[2] This previous restoration is not mentioned by Planiscig, *op. cit.*

the right forearm had three cracks close to the wrist; and the right hand was a new addition and was severed from the body. The left arm was broken at the elbow and again above the wrist, so that the hand holding the book was severed, but had been remounted with wooden dowels; the small finger of this hand was missing. The right and left legs were cracked. The terra cotta back was cracked with a very jagged line of breakage, extending from a height of about fifteen inches from the base on the right leg to about eight inches from the base on the left leg. Both legs were broken at the knees; the right knee joint was cracked; the right leg was broken at the ankle; and both feet were broken from the plinth.

The nose was new; the left ear was new and did not match the right one; part of the right ear was missing; and the tip of the left side of the beard extending to the jaw was new and did not correspond to the remainder of the beard. The back of the head was completely new extending from the top down to the shoulder, modeled over the wooden backboard. Sections of the sheepskin and the bands meeting in the knot on the chest were missing.

The entire statue was darkly overpainted and had, in addition, thick layers of hardened dirt and dust. As a whole, the statue gave the impression of extreme deterioration and disintegration.

PRELIMINARY STEPS IN THE RESTORATION

In order to evaluate what could and needed to be done, I first cleaned away the dirt and paint, until the original surface came to light. The cracks, breaks, and insertions of foreign materials became more readily visible.

Inasmuch as the wooden back and base did not belong to the statue, and as the wood exposed to variations of temperature and moisture had expanded and so contributed to the cracking of the terra cotta, it was imperative to remove them. The wooden board was fastened to the original terra cotta back of the statue by heavy iron hooks which were deeply cemented into the statue and bent into the wood. In order not to damage the statue, I cut away the wood piece by piece. This disclosed three long iron dowels cemented into the shoulders and upper back—one on each side and one in the lower center, forming a triangle (Fig. 2). The two upper iron dowels were set into the shoulders from the front running through the terra cotta from front to back. The heads of these dowels protruded to the front of the figure. The lower fastener was shaped from a flat iron band in the form of an eye with a finishing nail as a pin. Between board and terra cotta back was a layer of plaster of Paris about

Fig. 1. Front, side, and back views of the statue, upon its arrival for repairs.

Fig. 2

Fig. 3

Fig. 4

Fig. 5

three-eighths of an inch thick, with wooden laths lying crosswise as fillers (Fig. 3).

A center gap running from neck towards the lower back became visible (seen on Fig. 2). Whether this break existed prior to the insertion of these iron hooks or was caused by this crude fastening, or whether climatic conditions brought expansion of the log clamped between the three hooks causing the splitting, could not be ascertained. However, it was beyond doubt that the damage had progressed extensively. Other cracks running from the left arm towards the right elbow, and one just across the waist (from the left side), and the other minor cracks in the same area became visible simultaneously.

By cutting away another portion of the wooden back, I freed the statue from a large wooden dowel in the center in which was inserted a deeply cemented iron dowel. This revealed the break above the knees and separated the statue into an upper and a lower half (Fig. 4). These segments had been fastened by an iron clamp embedded in plaster of Paris. Large areas of the border where the original terra cotta was missing had been filled in with plaster of Paris and had been subsequently painted. In the middle of the back (about waist high) was an elongated hole filled with plaster of Paris (Fig. 5). After removal of all plaster of Paris from it, this proved to be the original indentation made by the sculptor to create a modeling hollow and vent (Fig. 6). This hollow runs down through the statue inside the back, coming out at a point in the crotch between the legs.

The removal of the remaining wooden back support disclosed many other criss-cross cracks and holes penetrating the back of the statue where the dowels were cemented. The two dowels ankle high also ran through the terra cotta (Fig. 7).

Heavy wooden dowels were set into the legs (above the knees) and were used to join the legs at the knees. This probably caused the various cracks in the knees (Fig. 8).

Upon removal of the excess plaster of Paris and cement from the back of the head, the original modeling of the skull and hair became plain. This then showed an indentation of the skull (see Fig. 6) made by the

continued on page 226

Fig. 2. View after partial removal of wooden backboard, center gap from neck to lower back.

Fig. 3. Plaster of Paris and crosswise wooden laths as fillers.

Fig. 4. Further removal of wooden backboard.

Fig. 5. Elongated hole filled with plaster of Paris.

Fig. 6

Fig. 7

Fig. 6. Original modeling hollow in head and back. Nuts cemented in holes to be used for supporting brass straps.

Fig. 7. Holes from removed dowels running through the terra cotta.

Fig. 8. Heavy wooden dowels at knee joints.

Fig. 9. Flat iron cemented into original head indentation.

Fig. 10. Original right foot removed from plinth and supplementary casting of left foot by previous restorer.

Fig. 11. Right foot where dowel had been inserted for mounting.

Fig. 8

Fig. 9

Fig. 10

Fig. 11

sculptor, as he had made the indentation in the back; it had been used by the earlier restorer to cement a long, crude, flat iron into this indentation as a way of fastening the head onto the body (Fig. 9).

THE PREVIOUS RESTORATION

At this time, closer examination of the statue revealed that in texture, color, and hardness, the terra cotta from the head down to just above the ankles was different from the terra cotta composing the ankles down to and including the base. More complete removal of the traces of the camouflaging by the previous restorer brought out the fact that the remains of the original now consisted of the portion from the head down to the breakage just above the ankles, that is, the right foot exclusive of its large toe, whereas the left foot, the plinth, and the corresponding part of the supporting back terra cotta (about eight inches high) were new terra cotta castings, done in a lower heat, and therefore of a different color, texture, and hardness from the original (Fig. 10). (Figure 11 shows the right foot where a dowel had been inserted for mounting.)

Now it became evident that a series of mishaps must have befallen the previous restorer who then was forced to do what he could to accommodate himself to the situation. He must have done the modeling directly on the original statue, most probably sculpting the missing parts to the statue in this manner. In the firing of these sections, however, the shrinkage proved to be excessive. He therefore resorted to a variety of devices to make up for this, when he applied these parts to the statue. Specifically, a gap between the length of the original right leg and the shorter new left one needed adjustment. He did this by setting a one-half-inch wedge between layers of plaster of Paris, forcing this between the plinth of the statue and the added wooden base (Figs. 12 and 13). This was designed to bring balance to the statue so that it would stand approximately plumb. In addition it was necessary for him to fill in the gap in the left leg and in the supporting terra cotta backboard with cement. To adjust the shrinkage of the left foot and part of the leg, he overmodeled the shrunken leg with cement so that it roughly corresponded in size to the right leg. I first assumed that the whole left foot, up to just above the ankle, was original but covered with cement to blend into the additional parts; how-

Fig. 12. Wooden wedge between plinth and added wooden base. Sharp angle on left foot shows removal of overmodeling, exposing shrunken foot.

Fig. 13. View of wedge and plaster of Paris on bottom of plinth.

Fig. 14. Chest in segments.

Fig. 15. Missing terra cotta around neck, chest breakage.

Fig. 12

Fig. 13

Fig. 14

Fig. 15

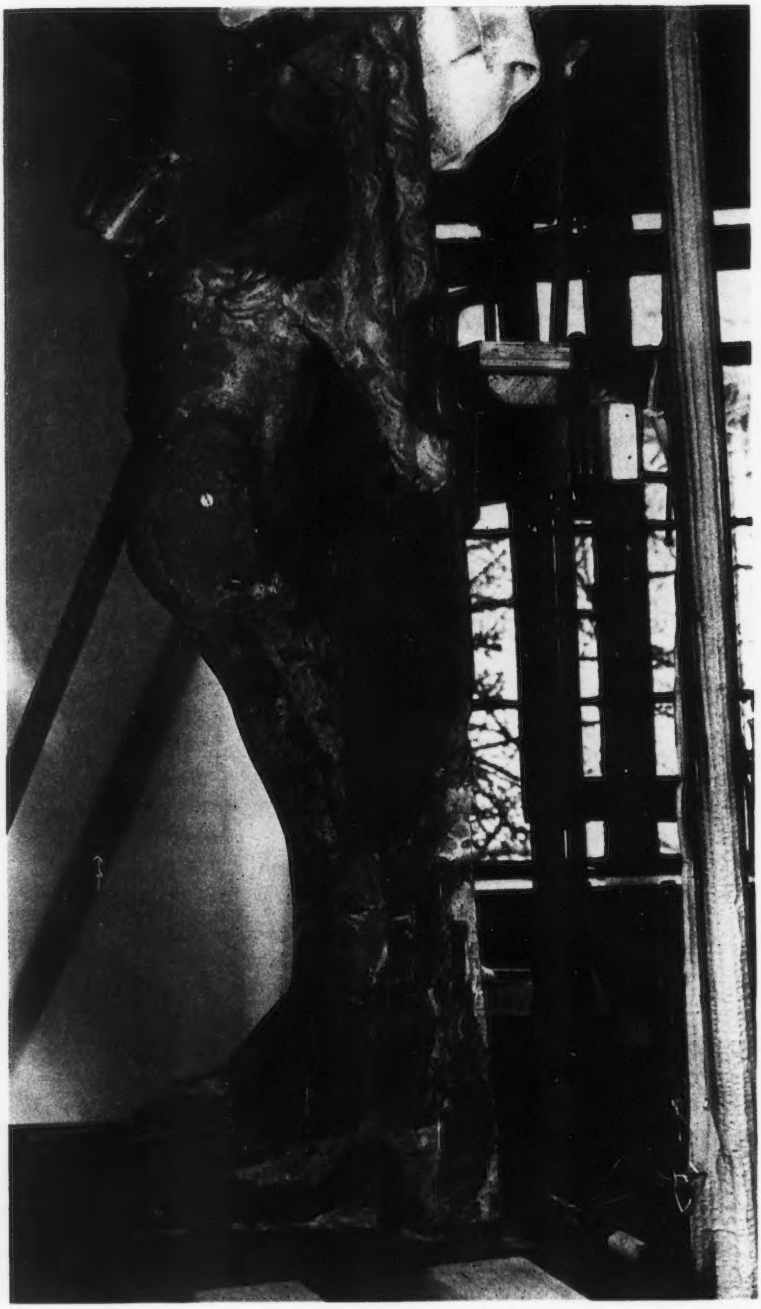

Fig. 16

ever, after cleaning away a part of the cement, I could see clearly that the left foot was a new addition. In firing, it had shrunk, and in order to bring it to the proper size, the previous restorer had to supplement the difference through overmodeling. When I was thus convinced that the original foot for which I had searched did not exist under the cement, I put the lifted parts back.

In the upper half of the body, similarly, incorrect and inaccurate assembling had caused further distortion. The crack in the chest, which had not been carefully fitted together, had become a gap in which the respective parts had shifted out of line. This gap had been filled in with cement (Figs. 14 and 15). Therefore, I took apart these sections, to reset them later.

Because of so much distortion in the assembly, it was inevitable that the head had been incorrectly set on. Furthermore, the previous restorer was not exact in affixing the head. Chunks of terra cotta were missing around the joint of the neck (Fig. 15).

The severed right hand also was shrunken, having been produced in a process similar to the one employed for the left foot. It had been mounted with an iron dowel and the gaps filled with plaster of Paris.

Additional evidence of the previous restorer's work was to be found in the replaced left ear done in soft clay and modeled differently from the right one. The nose had been recreated by the previous restorer, but he distorted the expression of the subject. The left point of the beard and the adjoining areas were new, but the modeling did not correspond to the original.

As a result of the statue's assembly and the complications due to the shrinkages of these later added parts of terra cotta, the entire figure was structurally weakened. This necessitated that the restorer reassemble and mount it on the wooden board and base with the dowels and clamps. Unfortunately plaster of Paris was used as the binder and filler; this material started and progressively worked towards the destruction of the statue through expansion and contraction.

THE RECONSTRUCTION

I started my process of reconstruction by removing the foreign wooden base and wedge and the excess cement, and setting the statue on its feet, plumbing the figure upon the plinth. The existing original right foot and leg unquestionably established the statue's original position. With this much set, the difference of the height of the shrunken left foot called for

Fig. 16. Left leg with cement replacement removed. Dowels for present fastening of new modeling visible.

adjustment of the plinth at the left leg. Inasmuch as this portion of the original statue was not available, I utilized the leg and foot provided by the previous restorer and remodeled them as much as necessary to make a mate to the original right foot and leg. With some reworking, I used the large right toe in the same fashion. The section of the left leg from a point on the outside of the thigh running down the outside of the knee and calf of the leg to the breakage at the joint above the ankle had been a cement replacement, partially visible (Fig. 16). In this restoration the proportions of the left leg were gross and poorly modeled, and therefore this new portion had to be discarded. I replaced this missing area, modeling to correct proportions taken from measurements of the right thigh, knee, and calf.

I aligned the sections of the chest and cemented the head on in accurate position.

I have replaced the small finger of the left hand. I have newly modeled the sections of the sheepskin, where necessary, and the bands of the knot tying the sheepskin so that the existence of the original knot becomes plausible.

Using other Minelli statues as guides,[3] I remodeled the nose, the left point of the beard and the surrounding beard, the left ear, and then completed the right one.

I removed the new addition to the modeling of the back of the skull and brought it back to its original form, adding only enough material to round off the edges.

I cleaned all breakage surfaces and then cemented all broken parts of the statue, resetting them accurately, without gaps, using plastic and bronze dowels and clamps, selecting the material of each dowel in accordance with the strength required.

It is remarkable that the original portions of the statue (even the broken parts) showed different colors, shading from golden and gray-yellow into deep, dark red. This might have been caused by uneven exposure to heat during the firing and/or differences in thickness of the material. The statue in its original conception most probably was polychromed. Whether the polychromy was originally intended by Minelli or decided upon in order to cover the different colors of the terra cotta is not revealed by the condition of the statue itself. The sharpness, delicacy, exactness, and perfection of the modeling all point to the fact that Minelli finished it in such a state that it could remain even unpolychromed. I

[3] See Planiscig, *op. cit.*

Fig. 17. Front and back views of statue in its present state of restoration.

have removed all new paints and gessos. I have left the scattered but barely existing traces (most prominent on the right forearm) of the polychromy that I assume from its quality to date from the creation of the statue. To achieve a more pleasant, uniform, over-all color, I blended in all the cement and modeling that I added, as well as the new terra cotta added by the previous restorer.

The statue is now strongly and safely mended and can be exhibited, with reasonable care in handling. As a final precaution, I replaced the wooden base and backboard by a bronze base plate mounted with two bronze supports on the back. These are screwed to the terra cotta statue in which nuts are cemented, and for which I utilized chiefly the existing holes (Fig. 17). This base and back support can easily be removed by removing the screws. The statue can stand, if desirable, without this support. The rough criss-cross cuts on the back made by the previous restorer have remained untouched by me, because I did not want to cover any portions of the original terra cotta where it was not necessary.

I left the base with the inscription intact, because the statue is known with this inscription in the literature, and it was in this state in the Pinakothek in Munich. The inscription reads as follows: "Vellano Patavinius opus A. 1470."[4]

[4] Planiscig, *op. cit.*, illustration 186.

II/3 1959

Science, a Public Heritage

ROBERT A. HELLMANN
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Institutions of research in science, whether universities or museums, either are directly supported by public funds or at least are exempt from the tax rolls. For this reason, such institutions must consider their findings as not exclusively their own but as part of the public intellectual property. Of course, some such institutions by their very nature are not in a position to deal directly with the public. In others, however, such as large natural history museums, teaching the discoveries of science is a moral obligation to the society to which such institutions have been born. We need only to look at the numerous reports in *Science*, and other similar publications, concerning the attitudes of school children and the general public towards scientists to realize how poorly the public is informed about scientists and science. Yet it is this same public which must produce scientists and support science. Is it too much, then, to ask that natural history museums tell the public what scientists have discovered and how they discovered it, and that these museums employ the knowledge and skills of professional teachers to tell it?

A masterful attempt at telling how scientists work has been made in the form of an exhibit on the work of paleontologists at the entrance to the Hall of the Giant Sloth at the American Museum. Cursory observations of my own indicate that, although few people stop to look at the exhibit, those who do spend sufficient time to read the labels and examine the material with apparent interest. The fact that they read the labels in itself indicates some success on the part of the exhibit. Further, their examination of the exhibit is often systematic, rather than haphazard, or at least appears to be. Even so, there may yet be room for improvement in exhibition methods. Perhaps further study of visitors' learning would tell us what holds visitors' attention and under what conditions retentive

learning is most likely to take place. I may at this point raise a few questions: How many exhibits are based on how visitors learn from exhibits, rather than on the basis of how museum preparators personally think the exhibits ought to look? How large is the human cone of vision? Are all capital letters easier to read than mixed upper and lower case? What should be the dimensions of letters to be easily read at a given distance by an "average" visitor? Do preparators know and use the answers to these questions and many more? How absurd it would be if the medical profession proceeded on the basis of how the practitioners personally thought the human body ought to be constructed, rather than on the basis of how their patients felt and performed as living organisms! Leonardo da Vinci once said concerning painting, "Those who are enamored of practice without science are like the pilot who goes into a ship without rudder or compass and never has any certainty where he is going."

Recently, when I suggested the application of a time-honored visual-aids principle to museum exhibition,[1] I elicited an alarmed reaction among those who thought that I was suggesting a change from the exhibition climate to which they had long been accustomed. One critic referred to me as a "critic of habitat exhibits," and lumped me with those who believe habitat exhibits to be a great deal of bother and possessing little worth.[2] The imputation was, of course, inaccurate. Indeed, one cannot really say that habitat groups as a medium of exhibition are categorically "good" or "bad." Whether a given habitat group or, for that matter, a motion picture or a film strip, is "good" or "bad" depends upon what its function is, how well the function is served, and how well the device is employed by the particular teacher using it.

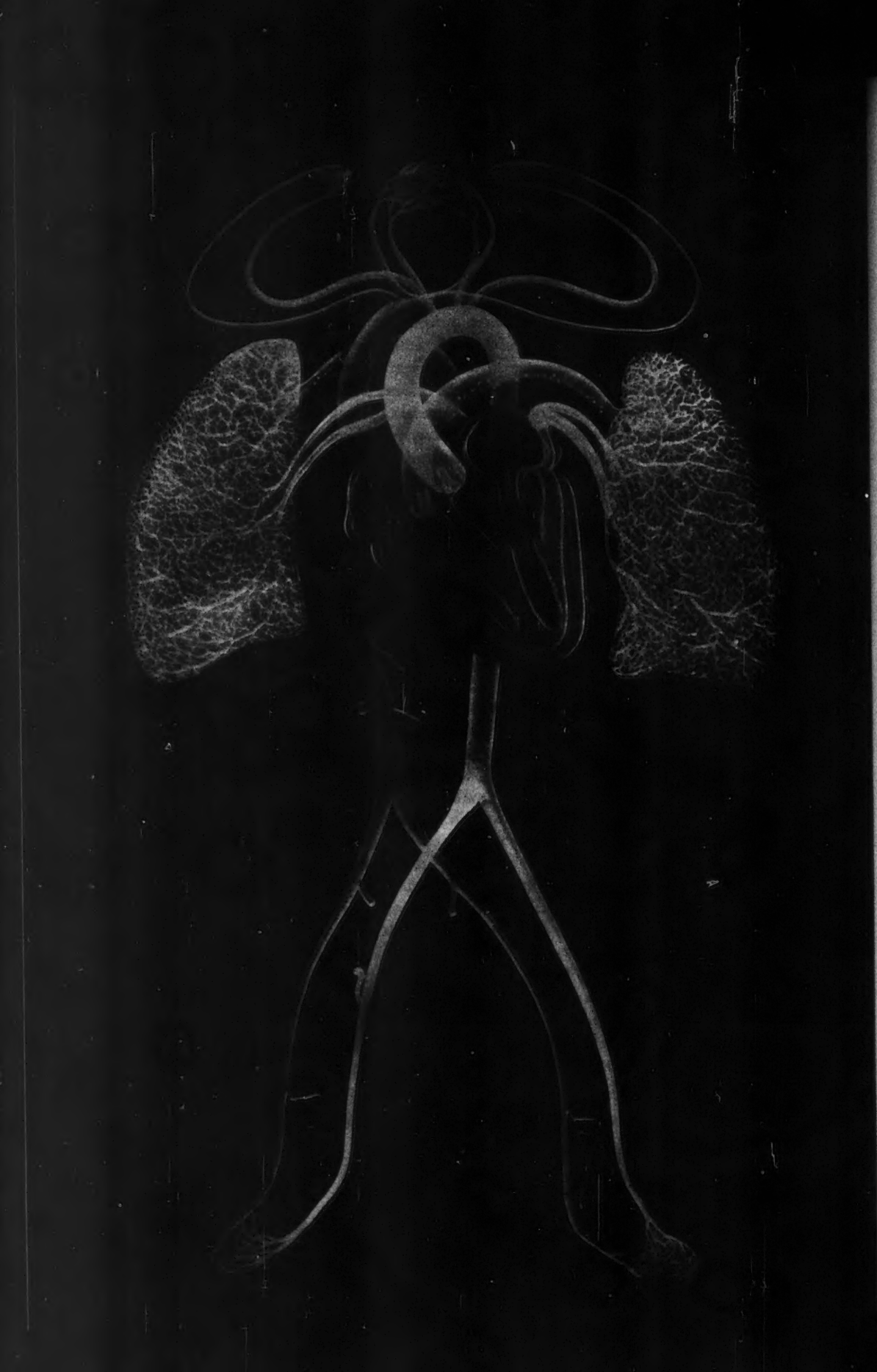
It is true that I selected a particular habitat group, the New Forest group in the Birds of the World Hall of the American Museum, as representing what I consider to be an ineffectual teaching method, namely, the crowding of a large number of specimens into a display area. The same critic admits that he does not know why Chapman put so many little birds into this group. I think the answer is simply that it represents the influence of the pre-habitat group era of crowding a large collection of specimens into a showcase. I think it is safe to say that the words "exhibit" and "display" should not be taken as synonyms. In this connection, I can only suggest again a comparison of the New Forest group with the beaver group in the Hall of North American Mammals in the American Museum, which I pointed out as a good exhibit educationally.

[1] Hellmann, Robert A., "The Teaching Functions of Exhibits," CURATOR, vol. I, no. 1, 1958.

[2] Amadon, Dean, "On First Looking Into Chapman's New Forest," CURATOR, vol. I, no. 3, 1958.

The concept of the beaver as a species is enlarged to encompass its behavior and relationship to physical and biological surroundings. Even more spectacular is the moose group in the same hall, which portrays the dramatic story of male aggression in the deer family during rutting. In contrast to those who perhaps consider these lessons less important than general impressions of habitats, I believe them to be lessons the public, now much interested in science, has a right to expect from our modern museums as a part of the public cultural heritage.

In raising the question of general impressions, Dr. Amadon stated that our education leaves us with few remembered details. I agree. He has stated the basis of my criticism of showcases crammed with specimens. However, it does not necessarily follow that teaching should consist of just general impressions. One may search for the origins of the general impressions that we glean from our education. Did our university mentors, for example, devote their lectures to vague impressions, or were they men of ideas? Could it be that scientific principles did not make valuable contributions to the building of that mosaic of knowledge and understanding which characterizes an education? I think I am able to say quite positively that my thinking has been greatly influenced, and I believe constructively so, by men of ideas who were able to lay before me principles of great significance. It is true that learned material tends to deteriorate, with time, in our memories. Every teacher is professionally concerned with this matter of forgetting. Yet I am sure that the fundamental principles and ideas that our educators gave us contributed significantly to the building of those general impressions we call education. These principles belong to the public as well. So also do the means by which they were discovered.



II/3 1959

Exhibit in Progress

HARRY L. SHAPIRO, CHAIRMAN, DEPARTMENT OF ANTHROPOLOGY
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An institution as old and as active as The American Museum of Natural History is bound to develop traditions and policies that give it a distinctive character. But the American Museum has acquired with time more than a mere character; it has achieved a personality. And like most personalities this one has facets that vary with the role it plays. To many of the Museum's widely scattered friends it represents a beloved wonderland of discovery, where as children they first glimpsed the vistas of time, space, and organic life so vividly that they have never forgotten them. To others, it is the august court of appeal on various scientific matters, the reluctant arbiter for puzzle fans lost among the flora and fauna of the cross-word jungles, the rich haunt of experts and *aficionados*, the generous storehouse of information for student essays and projects, the goal of holiday visitors to New York, the scene of TV shows, the weekend relaxation for countless city-bound families—in short, the delight of a public as varied as all America.

But the Museum has another side to its personality—a very serious one that is fundamental to everything it does. It is a research and educational institution. It considers that its job is to contribute to an understanding of the natural world in which we live and our place in it, and to disseminate the accumulated knowledge to the public.

Anyone familiar with the history of scientific and natural history museums knows that what was considered suitable or even possible to exhibit and the manner of doing so have undergone a veritable revolution during the existence of The American Museum of Natural History.

Fig. 1. Schematic model of circulatory system in routed Lucite, with flow of blood simulated by moving light source.

Fig. 2

In this remarkable transformation, generally known and appreciated but little commented on, The American Museum of Natural History has played a pioneering part. Its visitors have come to expect of it a willingness to experiment with subject as well as with techniques of display. As a result, the effectiveness of public education via the Museum has vastly increased, and the coverage of what it teaches has been greatly enlarged.

At the present moment, having recently opened its magnificent Hall of North American Forests, the Museum is in the midst of preparing for its public a new series of exhibits that embodies the spirit of experiment and adventure that has characterized its exhibition policy. When completed it will consist of a sequence of five halls devoted to man as a biological entity, to human behavior controlled and directed by social and cultural patterns, to the development of culture and civilization from its earliest beginnings, and to the story of human occupation in the

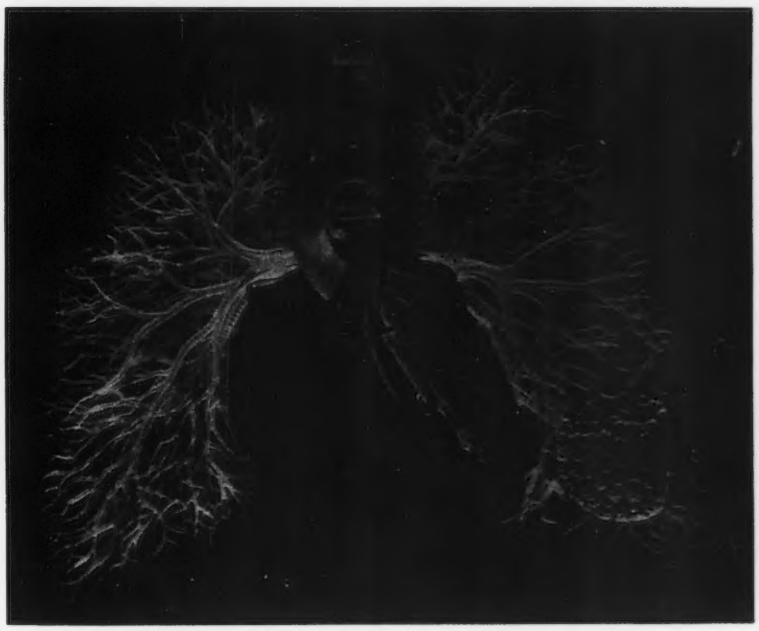


Fig. 3. Pulmonary circulation, with routed Lucite lungs and heart cast in Selectron.

Fig. 2. Entire circulatory system in routed Lucite.

Fig. 4. Bundle of nephrons in routed Lucite.

United States. Although these halls were planned more than a decade ago, with the purpose of bringing some of the recent and exciting generalizations of anthropology to the wide public the Museum serves, they had to wait for the necessary financial support that they require for their fulfillment. A few years ago, a generous contribution from Mr. John D. Rockefeller, III, made it possible to begin work on the first unit dealing with organic man.

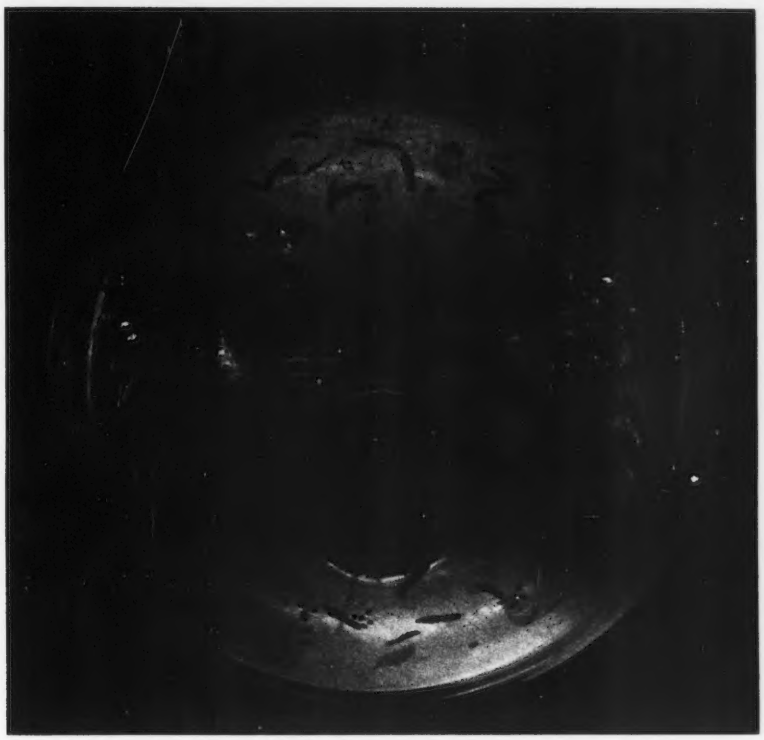
The plan for this initial hall calls for three subdivisions. The first

section tells the story of human evolution. Here the fundamental relationship of man to other organisms is set forth, together with an analysis of the mechanisms that led to the development of what we now recognize as *Homo sapiens*. Having brought man to this stage, the exhibits in the second section take a look at how such an organism functions. The final section views man as a member of a biological group and as an organism with an environment.

The range of problems in translating ideas of this kind into exhibits that are attractive, educational, and painstakingly accurate rarely occurs to the visitors who come to see and admire them. This is as it should be. Viewers of museum exhibits, like readers of books, should not be too aware of the mechanics involved in producing either.

Compared with other frankly educational institutions, the museum

Fig. 5. Lucite enlargement of generalized cell, with inner microscopic elements modeled in acetate.



approaches its function in a way that is essentially different. Its medium of communication is primarily the real object or a three-dimensional facsimile of it. The printed or spoken word, vital in school instruction, in the museum becomes subsidiary, contributory, or explanatory to the exhibit of tangible reality. This, of course, is precisely what makes a museum unique among educational institutions. As a teaching device the display of real things has enormous power. Nothing can quite replace the vividness of the actual object that can be seen or, under certain circumstances, felt. It conveys an immediacy that verbal descriptions or pictures can never equal. Besides this, it has the advantage of appealing to our curiosity and wonder and sometimes to our esthetic sense. All this is well known to museum people who are thoroughly aware of its advantages in teaching.

But the use of the object in scientific exhibits and for educational purposes imposes grave difficulties that tax the skill and imagination of the Museum's staff. Abstract ideas are often recalcitrant to this type of exposition. They do not lend themselves easily to concrete objectification. Having seen, however, a number of remarkable examples of the use of objects as symbols to convey highly abstract concepts, I myself no longer venture to set limitations of what can be done along these lines.

New techniques and new materials, as well as novel uses of older ones, often make it possible to demonstrate subjects that were once regarded as too difficult, too troublesome, or too expensive. Motion, for example, often adds immeasurably to the clarity of exhibits dealing with certain types of complex function. Experiments years ago with moving exhibits were tried at The American Museum of Natural History as well as in other museums. We found that they proved to be costly to maintain and to service and had to be abandoned. Now, by taking advantage of certain properties of sheet Lucite, we have been able to add motion to a number of demonstrations in the section of our new hall devoted to organic functions. A Lucite sheet when edge-lit transmits the light to the other edges of the sheet, leaving the surface unaffected. If the surface of the sheet is etched, however, the light applied to the edge will appear wherever the surface is cut. Thus by superimposing sheets of Lucite, each etched with representations of the successive stages of a cycle of action, we can activate them one after another as a light source passes across their edges and thereby produce action. Moreover, any color or combination of colors can be introduced by tinting the edges of the

Fig. 6. Miniature reconstruction of nervous system, in brass wire, with brain and spinal cord made of wax.

Fig. 6

Fig. 7

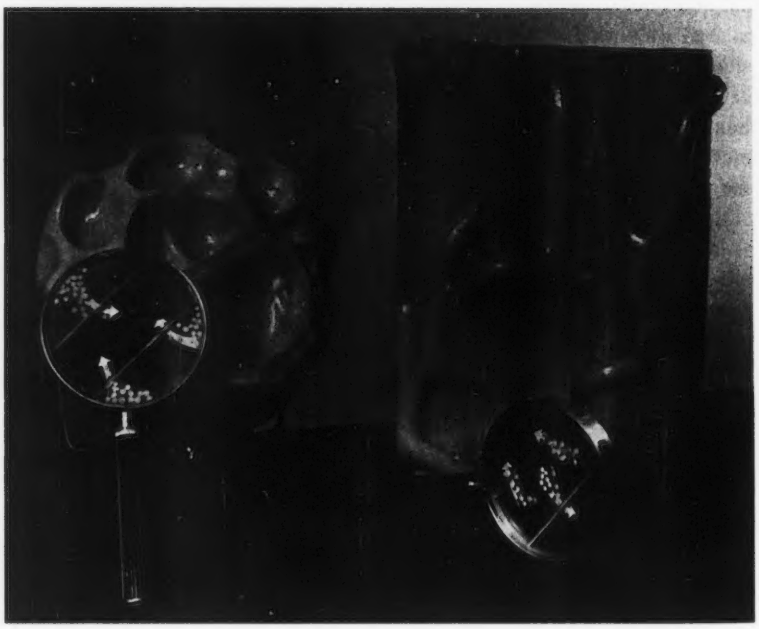


Fig. 8

Lucite sheets. In a single model we are able to demonstrate, for example, a pulsating heart in all the phases of a complete heart beat—the coördination of the opening and shutting of the valves and the pumping action of this organ that controls the flow of blood throughout the body.

This same technique has enabled us to show an ovum erupting from an ovary and passing down the Fallopian tube to the uterus.

Such demonstrations in action greatly enhance the impact of the conventional display and compress into a small area what might have required much more space in a static exhibit.

Because our primary purpose in planning the exhibits on the economy of the human organism was to analyze function and to carry the viewer down to the microscopic levels where essential processes were taking place, we were faced with particularly difficult questions of selection, technique, and accuracy. We had to decide at the very outset that our demonstrations were to be as up to date as we could make them, incorporating the latest discoveries, but to stop short of the controversial and uncertain fringes of research. It was tempting, time and again, to seize on some bit of dramatic and exciting work now current, but it had to be resisted. The danger was too great that costly exhibits based on tentative and unconfirmed research might become quickly obsolescent. We have, therefore, advanced only as far as solid expert agreement permitted. With a subject of this kind, where specialization is at an extreme, we were obliged to depend on expert advice. In a great medical and research center such as New York, some of the leading authorities in the world were available for consultation. To a remarkable degree we received the most cordial cooperation we could have expected. Distinguished scientists generously gave us hours of their time—criticizing, checking, and advising. In some cases the fruit of many years of research was turned over to us in the form of highly detailed drawings and analyses that our technicians could render in three dimensions.

The display on the kidney illustrates the kind of analytic methods we have employed to demonstrate essential function. Instead of proceeding from the whole to its parts, as we have done elsewhere, in this demonstration we begin with a single nephron, enlarged to about nine feet in overall length. Because a human kidney is about the size of a small fist and contains something like one million nephrons, an enlargement of this

Fig. 7. Cellular tissue models of bone (wax), skin (wax), and nerve (acetate and wire).

Fig. 8. Wax models of gaseous exchange in the alveolus of the lung and in muscle, with magnification discs in Lucite.

magnitude means that the viewer can get an unparalleled look at what goes on at the microscopic level of the kidney. What he sees is an enormous tube expanded at its head into a cup-like structure called a glomerulus. This encloses a tiny cluster of capillaries, or fine thread-like branches of the circulatory system. The blood passing through these capillaries is filtered. The elements filtered out begin to move down the tube. Some are reabsorbed into the blood stream according to the needs of the body. The rest continue their passage and, together with the waste products of the other one million nephrons, are collected in the pelvis of the kidney and eventually are passed out of the body.

Having shown how one nephron works, the exhibit continues with a model illustrating how nephrons are grouped in clusters and pyramids to make the complete kidney, which is itself illustrated in an enlarged, longitudinal section where its architecture can be studied. Whether it will fully justify our belief that even quite complex events can be made clear and understandable to the lay public remains to be seen.

Although any of us experienced in planning exhibits might have anticipated one of our major headaches (what to exclude), this proved to be a real worrier. The mechanism of the human body is full of so much interest and is compounded of so many fascinating details, all crying for space where space was limited, that the responsibility of deciding what to include and what to leave out was very great. Even now, after the decisions are all made, I continue to have serious qualms, and I suppose I shall have to face eventually the recriminations of those whose favorite subjects were not given, in their opinion, adequate treatment. We shall,

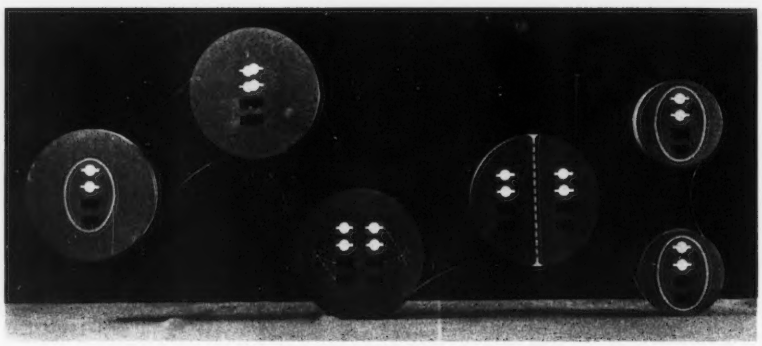


Fig. 9. Mitosis (cell division) shown by wooden discs on Plexiglas path.

Fig. 10. Endocrine control of organs and glands involved in the menstrual cycle. Model made of Styrofoam and plaster, with brass tubing.

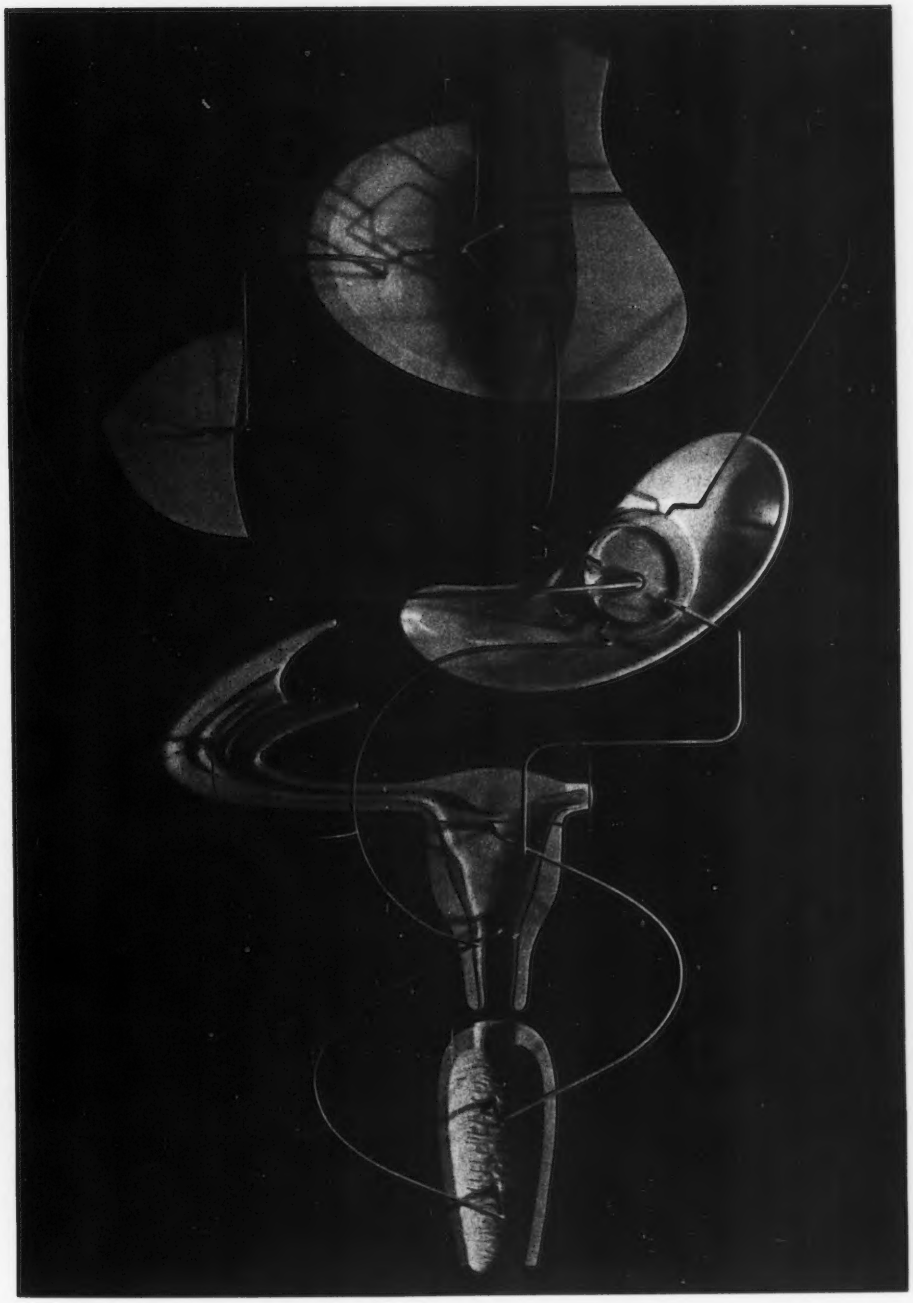


Fig. 10

Fig. 11

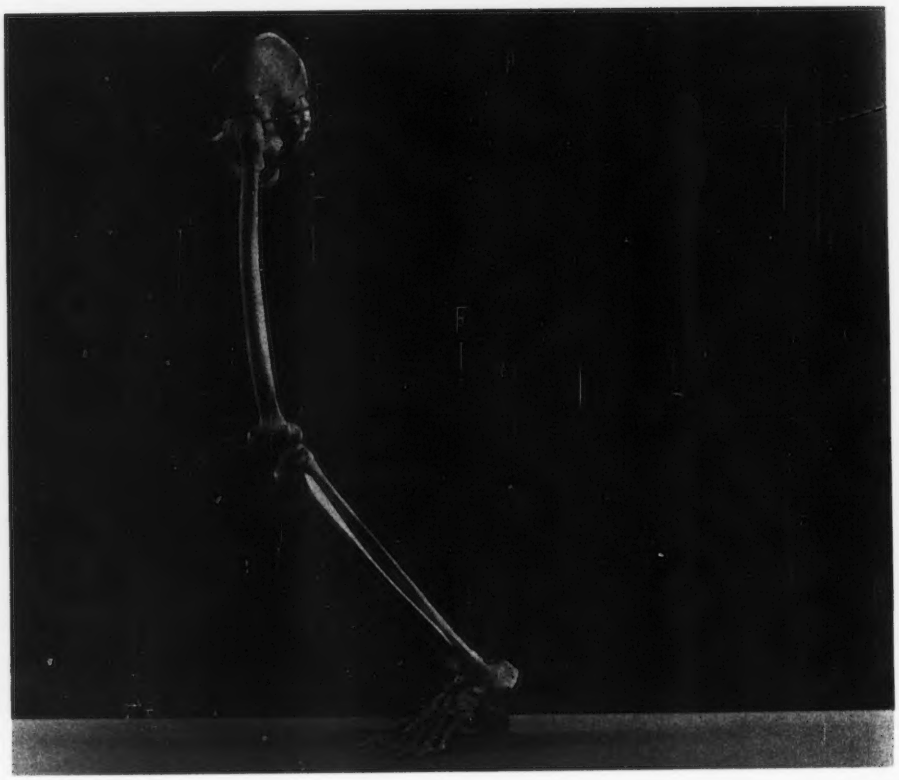


Fig. 12

however, feel rewarded if the over-all coverage gives our visitors a real insight into the marvel of a functioning human organism. We hope to achieve this by introducing the visitor to this section of the hall to a large, clear plastic reconstruction of a human cell—a generalized one, but with all the typical structure of a cell. The purpose of this exhibit is to establish the cellular basis of the organism and to reveal how complex the structure of the microscopic cell is. It is important to do this at the outset, because much of the physiology and chemistry of the body shown subsequently take place at the cellular level.

The exhibit continues with examples of specialized types of cells (specialized for specific purposes) and how cells are organized into tissues and organs. The cycles of particularly important cells, the reproductive cell, both ovum and spermatazoon, and their history after their union to form the new organism are traced out in detail. This leads into reproduction and birth.

The remaining exhibits then take up the various systems of the body. Each is treated in a variety of ways, but in all cases the aim has been to take the visitor to the working level where process occurs, and then to demonstrate the process. There are a few exceptions to this general rule governing the planning, imposed on us for lack of space or because the state of current knowledge does not provide the necessary information.

At strategic points throughout, the anatomy and relationship of the structures being analyzed are shown by models and by real specimens prepared by special techniques developed and perfected by Dr. Bernard Sills who has been collaborating with us. For example, a real heart and a real intestinal tract will be shown as they actually appear, without the need of preserving fluids.

The final section of the hall introduces the visitor to the concepts of individual variation, population genetics, and the relationship of man to his environment. Demography, the dynamics of population growth, one of the major problems of the world today, belongs in this section. Population as a group of organisms out of which emerges a kind of group biology is the theme here.

All this, then, forms a transition to the succeeding halls on human behavior and the development of civilization—halls that must wait for their embodiment as exhibits until funds are available.

Fig. 11. Middle and inner ear, modeled in plastic, wax, Selastic, and cellulose acetate.

Fig. 12. Human locomotion demonstrated by pelvic, leg, and foot bones and aluminum cutouts.

Fig. 13. Enlarged drawing of synapse (nerve-meeting) in ink and gouache.

This kind of exhibit represents an enormous advance in the detail and complexity of a general public museum demonstration. If it is a resounding failure, I am convinced it will be not because of lack of public interest or inability to grasp the fundamentals of the subject. It will be because somehow the right terms were not found. In an experimental venture such as this, with virtually no precedents to guide us, the chances of success must be weighed carefully and the exhibits designed to carry a message to a variety of people. This, indeed, is one of the most difficult of all the aspects of the art of museum planning.

Unlike formal educational institutions, any museum, and The American Museum of Natural History in particular, faces a curiously challenging

task. Although it has the very great advantage of communicating with a public that is willing and eager to see and perhaps to learn, it does not limit or select its visitors on any criteria based on age, knowledge, or preparation as do schools and colleges. It receives a public that ranges from children on upward, from neophytes to highly trained professional students, from the dull to the bright. And it exerts no pressures to hold the attention of its visitors beyond the inherent attraction of its displays.

This challenge has been constantly in our minds in all the preliminary planning for the new hall on the biology of man. We have been aware of the needs of the medical students who in this great medical center have had no place where they could see visual reconstructions such as will be available at the Museum. They will find embodied in the displays the fidelity to nature they rightly demand, and it is our hope that the displays will form a valuable adjunct to their educational resources.

At the same time the exhibits are planned to be meaningful and inspiring to the public, with or without special knowledge or background. For the first time New York will have a public exhibit to which anyone may come and learn something of the delicate and marvelous processes that sustain life in the human organism.

(Editor's Note: The techniques mentioned here in the preparation of Lucite will be described more fully in a forthcoming issue of CURATOR.*)*

Fig. 14. Dr. Shapiro examining three stages in the preparation of an enlargement of a pyramid section of a kidney. Finished model (right) is of plaster.

The Museum and the University

JOHN A. MUNROE, CHAIRMAN, DEPARTMENT OF HISTORY
UNIVERSITY OF DELAWARE

Sometimes the relations between a museum and a university are entirely an intramural problem, as at Pennsylvania, Harvard, and Vermont, where the museum is part of the university. But the independent museum, the museum that is not part of a university, may also seek some cooperative relationship with a university in order better to fulfill its functions as a museum.

It is natural that the relationship of a museum and a university should be close, for they have essentially the same functions. Both conserve the heritage of the past and disseminate knowledge of it to present generations. In many cases—ideally in most cases—the museum and the university seek not merely to conserve and disseminate knowledge but also to add to it. They emphasize different devices, of course—art and artifacts are the symbols of the museum, as library and laboratory are the symbols of the university—but neither has a monopoly on its methods or its materials.

Yet they are sufficiently different that they should be complementary rather than competitive. The museum has things to exhibit, materials to be seen, and, in most cases, a small group of people with specialized knowledge about these things and with the duty of displaying or explaining them to an enormous and unlimited clientele. The university, as its name implies, comprehends almost every imaginable interest, includes a large company of scholars and students, and essentially performs its functions (barring such exceptions as extension services) for a fixed, limited clientele—the student body and the scholarly world.

Where the museum and the university lie in close proximity, they may draw upon each other. The material treasures and the specialized skills of museum staffs should augment the work of the scholars and students at the university. The catholic interests of the university should supplement and stimulate and serve the smaller staff of the museum.

All this is obvious. It is a relationship that can take place informally and undoubtedly does to some extent take place (within the limits of human willingness and adaptability) wherever a museum and a university are located close to each other. But my concern is with a less obvious and less informal connection between a museum and a university. In Delaware and in several other places elsewhere in the nation, formal programs of education have been established through the cooperation of museum and university. Perhaps at the heart of these cooperative programs lies the desire to use the material treasures of the museum in such a way that students may, in studying them, receive credit towards degrees. Because degrees, as symbols of the acquisition of knowledge, are a monopoly of the university, there must be cooperation between the university and the museum if the museum is to be utilized in any program leading towards a degree.

In some cases the marriage of convenience that pursuit of the academic degree forces upon the university and the museum is not a happy union. A program leading to a degree may bring to the museum a new and undesirable type of student—the grade-grubber, the degree-monger, the so-called student who enters the museum not willingly and joyfully to see and to learn but meanly and designedly to accumulate credit hours and degrees, not for pleasure and knowledge, but for a job and a salary he might not otherwise secure. Jobs and salaries, particularly teachers' jobs and teachers' salaries, are usually hinged upon an accumulation of credit hours and degrees, and the result is that the acquisition of hours and degrees to some people seems to be more important than the acquisition of knowledge.

This problem can annoy both the museum and the university. It may, of course, lead a museum director to feel that he would prefer to have nothing to do with course credits and degrees, and therefore to confine his education program to students who seek knowledge, not credit hours. But other problems may cause friction between a museum and a university. One such problem may arise from the different organization of the two institutions. A museum, generally a smaller, more single-minded unit than a university, may have a streamlined organization with responsibility clearly fixed, such an organization as can quickly and effectively meet a new problem or effect a change in policy. A university on the other hand (despite all the complaints regarding the enlargement of the administrative hierarchy) is comparatively large and unwieldy. Out of its multiplicity of interests and services and also out of the essential individualism and spontaneity of scholarship arises an organization that cannot easily be streamlined, unless its vitality is to be sapped, and is not easily amenable to changes of policy. With varying and somewhat indefinite degrees of responsibility and autonomy at the level of the school, the division, the

department, and the individual professor, the university often seems to present a picture of confusion and indecision to the museum director. Which dean should he speak to about which problem, he may wonder. Or if he deals with a department chairman, is he conferring with a permanent head of a department who will carry out policies he agrees to, or with the holder of a chairmanship that rotates among a cabal of professors?

The idiosyncrasies of professors may also pose a problem for the museum director and the museum staff. Every professor worth his salt thinks that not only his own special subject but his favorite branch of that subject is of particularly great importance. The historian, for example, is likely to think of history as the one all-encompassing cultural study, while the chemist argues that the whole world moves by means of chemical reactions. Although his enthusiasm often carries him to extremes, the professor must feel his subject is an important one or he cannot justify devoting his life to it, particularly in view of the inadequate financial compensation. But an understanding of professorial enthusiasms will not always save the museum director from being embarrassed by interdepartmental friction and rivalries.

While maintaining a strong prejudice in favor of their own fields of study, professors of the liberal arts are apt to be suspicious of any sort of vocational courses. If a course in museology is broached at the undergraduate level, a negative professorial reaction is to be expected. The fear is, of course, that the content of the curriculum will be watered down, and the professors will be as wary of courses in "how to conduct a museum" as of courses in "how to teach" or "how to type," even though they may have no doubt of the utility of such courses.

In one way or another most of these problems have been avoided in the cooperative educational programs being conducted by the University of Delaware and the Winterthur and Hagley museums, possibly at the risk of limiting these programs more than they need be limited. For instance, we avoid grade-grubbers and degree-mongers by restrictions on the number and quality of our students. We have admitted to our programs only a carefully chosen group of graduate students, most of them on fellowships. In the Winterthur Program (the name for the program conducted jointly by the University of Delaware and the Henry Francis duPont Winterthur Museum) five new Fellows have usually been appointed each year. The fellowships are for two years of study, and consequently the total of first-year and second-year Fellows is usually ten. In the Hagley Program (the program conducted jointly by the University and the Hagley Museum) two new Fellows are appointed each year. Because this is also a two-year program, the maximum number of Hagley Fellows at one time is four.

If our screening procedures did not keep our programs free of grade-grubbers and degree-mongers, our curricula would, for we know that our programs demand more work of the students than anyone looking for an easy degree would ever want to do. We avoid any charge of watering down a liberal arts curriculum by the fact, first, that our programs are for graduate students only, and, second, that, though they do include "how-to-do-it" courses, they also include more than the usual number of subject matter courses for the Master of Arts degree. The Winterthur Fellows take the M.A. "in Early American Culture"; the Hagley Fellows take the M.A. "in American History." In the one case art, in the other case industrial history, provide the central motif for the curriculum. In both cases the students spend approximately half of each week during the academic year at the university and the other half at the museum.

Over the years (the present is the seventh year of the Winterthur Program and the fifth year for the Hagley Program) we have worked out administrative devices (centering responsibility in committees and individual coordinators) that help us to avoid unnecessary friction. Our path is made smoother, too, because we have come to know each other well by doing many things together. We share guests, for example, such as visiting scholars who come to lecture at the museum or the University or both. We have, to some extent, sat in on each other's courses; five members of the University faculty have audited an introductory five-week course given to all new Fellows at the Winterthur Museum. We have found it advisable to establish a fixed curriculum for each program which all Fellows in the program must follow.

At the University each student takes two courses a semester for four semesters. These courses alone, with the thesis that each student writes, equal the requirements for an ordinary M.A. degree. But the degrees received by the Winterthur and Hagley Fellows represent considerably more work than the usual M.A. degree, because these Fellows have had special work at the museums in addition to the full university programs. Furthermore, the work at the museums consists not only of vocational, or "how-to-do-it," courses, but additional work of the customary academic type. The thesis, moreover, is usually a far more thorough study than the average Master's thesis. The justification for demanding so much work is, first, that we want these degrees to carry a special prestige; second, because our students are carefully selected and, in most cases, receive a fairly liberal stipend (about $2000 a year), we feel we may require considerable work from them; and, third, as we hope to prepare them at one and the same time for either continued graduate work leading to a doctorate or for immediate placement in museum work, we feel we must give them all the usual M.A. training plus special museum experience.

The courses that the Winterthur Fellows take at the University, eight

in number, are three in art history, three in history, and two in American literature. The three art history courses are in European backgrounds, colonial American art, and art of the early republican period, respectively. The emphasis is upon painting and architecture rather than upon the forms of art in which the Winterthur Museum is strongest. The third and last of these courses, in chronological order, ends at about the year 1840, because that year roughly marks the termination date of the Winterthur collections. "Early American Culture," therefore, in the sense in which we employ the term in the Winterthur Program, refers to the culture of the continental English colonies and the United States prior to 1840.

The three history courses follow the same chronological pattern as the art courses. One deals with seventeenth-century and eighteenth-century England, the second with the American colonies, and the third with the United States from Independence to 1840. The emphasis is upon social and economic history.

The two literature courses emphasize intellectual history rather than belles lettres. One is concerned with the "Main Currents of American Thought" in the colonial period; the other, with the same subject in the early republican period.

Every Winterthur Fellow takes every one of these courses, even if he has already done some graduate work (several of our Fellows have received a Master's degree from another college or university before coming to us). Because the courses are taught largely as seminars, there is likely to be little dull repetition of previous work taken elsewhere, and we have felt a gain in spirit by keeping the Fellows together.

The Hagley Fellows take all of these courses at the University, except the courses in art. For them a course in the social and economic history of the United States in the late nineteenth century and two courses in the history of science, largely European in emphasis, are substituted. As far as possible, we put the Hagley and Winterthur Fellows in the same classes at the University, because we think the competition is helpful to both groups.

At the museums the two groups of Fellows pursue very different programs. The Winterthur Fellows devote two-thirds of their time at the museum to what is called the "Winterthur Museum Laboratory Course," consisting of a sequence of three semesters of work and two five-week summer seminars. Through this course members of the Winterthur staff introduce the Fellows to the Winterthur collections, direct them in the study of the American decorative arts and crafts and the sources of American design, and train them in the principles and practices of museum curatorship. In addition to lectures, research papers, and tests, the students gain experience in guiding and in public speaking, make field trips, and receive training in the various departments of the museum.

A second course at the museum, covering two semesters, is entitled "The Arts and Society in Early America" and is a study of the social and cultural implications of selected examples of the major and the decorative arts in North America before 1840. Neither this course nor the laboratory course is given during the third semester, for in that semester, the beginning of the second year, Winterthur Fellows are freed of almost all museum responsibilities in order that they may concentrate on the Master's thesis, which is completed by the end of January.

The program of instruction of the Fellows at the Hagley Museum necessarily differs from that at Winterthur because of the difference in the nature of the two museums. In their first year the Hagley Fellows are given a course in the industrial history of the surrounding area from its earliest settlement to the developments of the nineteenth century. Particular attention is given to the milling industries (flour, paper, textile, and gunpowder), which flourished on the Brandywine. Concurrently with this study, the Fellows are assigned, on a sort of interneship basis, to the various experts on the Hagley Museum staff to be trained in archival and library problems and in museum techniques and philosophy. Later in the year seven sessions on business history precede assignment to the exhibits laboratory at Hagley or (during the present year for the first time) to the Historical Society of Delaware for a six-week period. A year-long research project is also assigned during the first year, usually some special piece of research desired by the museum.

In the second year, Hagley Fellows are given some free time for their theses. They report to the museum only one day a week for varied assignments in guiding, curatorship, and research, and in this term as in others a limited number of field trips are made. A final seminar in American science and technology completes the work of the Hagley Fellows.

Various perquisites are attached to both programs. Because the museums are about fifteen miles from the University, the students are given a sum of money to cover the cost of commuting. Additionally, they are allowed transportation expenses for a certain portion of the travel to other museums and to libraries that is demanded of them. While a certain amount of guiding is required as part of their instruction, Winterthur Fellows have been permitted to make extra money by guiding in free time or in the summer. Hagley Fellows are employed by the museum in the summer after their first year, yet are given part of their time free for thesis research.

Our programs are certainly not perfect and are still undergoing change, but both are old enough to have worked out the kinks that accompany any novelty. We are proud of our graduates. The University faculty who taught them have no fear that their academic training has been slighted to allow time for museum training. To the contrary, we feel they have

completed more work than the graduates of any Master's program in a comparable field. That they know something about the purchase of antiques, the cataloguing of exhibits, the preparation of a diorama, and the technique of giving a slide lecture does not in any way detract from their knowledge of American art, science, history, or letters. They ought to, and they do, I believe, command higher salaries and win better grants than other Masters who have not had this broad training. The museum fellows have learned not only to read, but to see.

The Boy Who Breathed on the Glass in the British Museum

CURATOR exhumes a moral tale as meaningful today as when it first appeared in 1916. Subtitled "A Criticism of Life," these drawings by H. M. Bateman were published originally in PUNCH, and subsequently included in A BOOK OF DRAWINGS (Methuen, 1921). Small boys and museum maintenance problems are little changed forty-three years later, although the ratio of the former to the latter has undoubtedly increased.

Our thanks are due to the estate of the artist for permission to reprint this fable.

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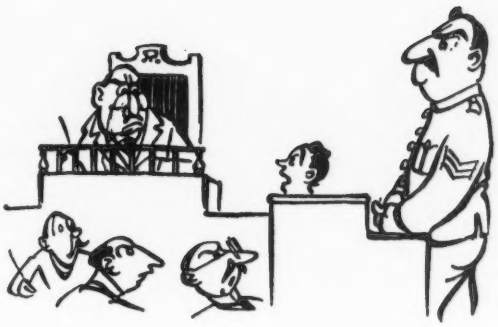

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H.M. BATEMAN. 1916

II/3 1959

The Planetarium Lecture

THOMAS D. NICHOLSON, ASTRONOMER
THE AMERICAN MUSEUM–HAYDEN PLANETARIUM

The planetarium lecture occupies a rather unique position in an age in which television, radio, and motion pictures dominate the competition for the recreational time of the American public. Planetariums present what is probably the most popular, successful, and heavily attended lecture program in our country today. Over 600,000 persons annually attend the lectures in New York at The American Museum-Hayden Planetarium. Annual attendance in the eight large planetariums conducting schedules in the United States exceeds 2½ million persons.

The planetarium lecture is not easy to describe or to analyze. In its most elemental form, it is simply a lecture on an astronomical subject illustrated by means of a special projection device which is capable of reproducing the sky quite realistically. At its best, it combines the formality of the lecture hall, the spontaneity of the classroom, the exhibition of the museum, the showmanship of the theater, and the casualness of conversation. Many talents go into its planning, production, and presentation. A great many intricate, expensive, and unusual projection devices are used to produce its visual impact.

The production of a planetarium lecture involves the skills and experience of astronomers, educators, artists, design technicians, machinists, photographers, projectionists, and, of course, the lecturer himself.

The astronomer and educator are responsible for planning the program of lectures. In a sense, they are the production team of planetarium presentations. The program they develop, and each individual lecture in the program, must meet certain standards. First of all, the lectures must be consistent with the objectives of the institution. Secondly, they must reflect the science of astronomy correctly, honestly, and realistically. Thirdly, the lectures must be planned in accordance with sound educational theory and adapted to audience age and background. They must be logical and

should employ sound principles of audio-visual education. And, finally, the lectures must be interesting and entertaining.

In selecting the topics for the lecture program, the astronomers and educators who are the planning group of the planetarium must consider many factors. There may be certain topics which, because of events that are occurring at the time, will be of special current interest. Such events as eclipses, the appearance of comets or novae, configurations of the planets, sunspot cycles, and outstanding planetary phenomena fall into this category. Other lecture topics are stimulated by events or programs in astronomy or science, such as the International Geophysical Year, the rocket and satellite research program, the inauguration of new observatories and telescopes, and the announcement of new astronomical discoveries. Some lectures arise naturally from anniversaries or festivals; the Easter and Christmas programs, and programs based on historical events, are examples.

Another important consideration in the selection of topics for the program is, of course, the nature of the audiences expected. During certain months, large numbers of school classes attend the planetarium. Public lectures during these months should be related to the curricula in astronomy and science of the schools, unless special lectures are planned for the school classes. The audiences attending during summer months are, on the other hand, largely adult, and often include large numbers of tourists vacationing in the city. Lectures during these periods might emphasize the subjects of current or topical interest.

Following the conception of the program, the planning and production of each lecture involve certain broad functions for the astronomer and educator. The lecture topic must be developed in theme and in scope; specific subject matter must be selected, limited, and organized in a logical and suitable sequence; supporting visual material must be selected or developed; and suitable media for its presentation must be similarly selected or invented. These broad functions must eventually be narrowed to specifics, and it is here that the astronomer-educator production team must work with and guide the other personnel involved in the preparation of the lecture: the artist, design technician, photographer, projectionist, and lecturer.

A good deal of the visual support in the lecture is provided with the projection planetarium. This instrument is practically the *sine qua non* of the planetarium program. But it is limited, in its visual display, to a demonstration of the positions and motions of the celestial objects that are visible to the unaided eye. In skillful hands, and with imaginative planning, much can be done with this basic instrument. American planetariums have found it to be desirable, increasingly so in recent years, to present far more visual material than that permitted by the planetarium

projector. This additional material might include telescopic photographs of astronomical subjects, panoramic displays of scenery, sky-filling environments, and purely esthetic presentations of light and color. It is this phase of the program that requires the skills of many additional persons on the planetarium staff.

There is hardly any astronomical subject, motion, scene, theory, or proof that cannot be presented visually in a planetarium presentation. Elaborate devices, and combinations of devices, have been developed and built to permit projection of the great range of materials that go into the lectures. It is almost an axiom in the large planetariums of the United States that nothing is described in the lecture that is not also supported by some visual material.

The selection of astronomical photographs for projection in the lecture is, of course, the problem of the astronomer and educator, in their roles of producers. But many of the objects and scenes that are to be shown during a presentation have not been, and cannot be, found in photographs. Thus a great range of material must be executed by the artist. His own sense of imagination and design, combined with the guidance he receives from the astronomer, must permit him to develop illustrations which will be both pleasing and realistic.

The artist must be supplied with models or patterns, must be advised concerning color, dimension, ratio, or perspective that may or may not be used. He in turn must accept the limitations of frame ratios in projection, standards of legibility, tonal or color range, and contrast. Allowances have to be made for the artist's medium, and he must be allowed certain license to interpret reality in an attractive manner. But the artist's work will be absolutely useless to the planetarium lecture, in spite of how attractive it may be in the original, if it fails to achieve the desired results in projection.

The skills of the machinist and design technician come into play in devising the sometimes very complex equipment that is needed to project illustrations in the desired manner. Basically, only three methods of projection are available to illustrate the lecture. These are the motion picture, the lantern slide, and the pin-point projector. The design technician must be sufficiently skilled in the principles of optics, mechanics, model making, electricity, and instrument making to adapt these three basic projection techniques to the needs of planetarium presentation.

The pin-point projection in its simplest form is merely a high-intensity light source placed behind a diapositive. The image of the diapositive is cast as a shadow on the planetarium dome, as on a projection screen. This simple principle has been developed, through suitable design, into devices that produce illusions of moving cloud formations, thunderstorm activity falling snow, swirling gases, the interior of an observatory dome, and a

map of the earth that fills the entire dome of the planetarium theater from a geocentric perspective.

The motion-picture projector has the disadavantage, in planetarium use, of always appearing in a rigid and obvious frame. But the frame can be modified to other than the obvious rectangular shape, or the projected image can be placed in an artificial frame supplied by some other medium of projection, so that the motion picture becomes part of a broad scene, appearing to be a natural and dynamic feature of an otherwise static scene. And, finally, the frame can be made to move on the vast projection screen of the planetarium dome to add another dimension to the characteristic motion that can be achieved by this technique.

The majority of supporting projectors used in a planetarium lecture are, however, slide projectors. The slide projector can be modified in many ways to produce a variety of effects that bear little resemblance to the ordinary static presentation of slides. Groups of projectors are arranged so that they contribute to a panoramic scene, with little or no evidence of the individual pictures. Suitable art and photography can produce images on the slides that do not have the characteristic frame of the slide. Rotation can be introduced into the image, and the image can be moved in any desired path on the planetarium sky, at any speed. Slide projectors can be modified to dissolve images slowly so that they undergo systematic changes, to cause an image to grow larger or smaller as though approaching or receding, and to group several stationary and moving images to recreate an astronomical scene that is actually dynamic, such as an eclipse of the sun or moon.

The choice of a projection technique to achieve a given visual effect in a lecture involves the astronomer, educator, and the design technician. Specifications for the projection apparatus, in terms of image size or area, direction and speed of motion, position in the sky, brightness, and the sequence to be followed must be provided by the production team, which is familiar with the technical or educational demands of the desired effect. Guided by these limitations, the design technician selects the suitable medium, plans the modification necessary, and, with the aid of the machinist, constructs the apparatus that is needed. It is also his task to install the device in the planetarium theater and to adjust and service it as necessary.

Expert photography is necessary to complement the work of the artist and the design technician in achieving a desired projection effect. The photographer must be familiar with the objectives and the use of the material he is given to work with. This will help him in precisely filling the requirements of the astronomer and educator concerning astronomical photographs to be reproduced in whole or in part.

The large obstruction in the center of the planetarium theater—the pro-

jection planetarium device—prohibits projection of images diametrically across the chamber. Projection must always be along chords of a sphere, which brings about distortion of projected images through a parallax effect. If he is aware of the problem, the photographer can assist by correcting for the parallax in the photography, where correction is needed. He is also required, at times, to work in very precise dimensions, when the product is to be part of a broader scene. And he must always be aware, in copying either art or photographs for use in the lecture program, of the tonal scale or color range and the contrast required to process the material given to him into suitable projection film.

The success or failure of any given lecture in a planetarium will always depend upon the lecturer and projectionist who present it to the audience. The projectionist must monitor the lecturer carefully, providing him with the required audio or visual material at the precise time and in the manner best suited to support the lecture material.

In the development and rehearsal of the lecture, the projectionist must work carefully with the astronomer-educator production team to interpret the needs of the lecture in terms of the audio-visual material he controls. He will very often be required to make the recordings—music, voice, or sound effects—under the direction of the astronomer. The level of the sound playback and the illumination levels for room lighting and projection are set for standard conditions during a rehearsal or in the preliminary lectures of a presentation. But the technician must be alert to the need for adapting these to the size of the audience, the audience reaction, and the pace of the lecturer.

The lecturer has the all-important role of interpreting and adapting the presentation to the actual audience present. He must, of course, be familiar with the subject matter of the presentation, the objectives of the producing team, the sequence of audio-visual effects and topics that are planned, and the details of producing or signaling for the scheduled effects in a precise time and manner.

The lecturer's presentation should be fluent, casual, authoritative, and interesting. At the same time, he must have the presence of mind and dexterity to control the projection planetarium and his share of the supporting visual effects without interruption in his presentation. It is very often imperative that he maintain a rigid time schedule, not only for the total duration of the lecture, but also in timing the sequences that are part of it so that they coordinate precisely with visual effects.

The lecturer should not deliver his material from a prepared script, either read or memorized. His guides should be the outline of topics and visual effects planned for the presentation, his knowledge of the subject material in general, and his experience in teaching and lecturing. He may refer to a brief outline of personal notes in several of the early lectures he

presents, but he cannot afford to use the time, attention, or the illumination that are needed to refer to notes as a matter of practice. He should, as quickly as possible, become sufficiently familiar with the outline of topics and effects so that he needs no reference or reminder during the lecture.

An average of forty lectures per week is presented at The American Museum-Hayden Planetarium. Including those on the staff who contribute to the planning of the program, nine lecturers and three projectionists share in presenting the lectures. In any one presentation, as many as 150 auxiliary projectors, in addition to the projection planetarium, may be used for the visual effects. There are obviously many combinations that can be represented in the single lecture that a visitor may attend.

The lecture program is only one of many programs included in the activities of the planetarium. But the vast bulk of planetarium visitors gain their first, and often their only, impression of the planetarium from their experience at this activity. And, in many cases, this is the only exposure to semi-formal astronomical education for most of them. In the nearly thirty years in which planetarium institutions have been operating in the United States, the lectures have reached a very significant proportion of the population, and have undoubtedly contributed a great deal to the renascence of astronomical interest that is so obvious today. The results of the lecture program seem well worth the many skills and the careful planning and production that are necessary for them to be presented at their best.

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A Plea for Abundance

A. E. PARR, DIRECTOR
THE AMERICAN MUSEUM OF NATURAL HISTORY

According to the density and arrangement of specimens on display we may speak of three basic styles of exhibition: storage display, serving only the housekeeping problems of the collections; choice and sparse selections, for the initiate, for the aspiring devotee, and for the casual window shopper; and abundance, for the adventurous browser eager to develop his knowledge and appreciation by personal experience and choice. Two of these can be quickly disposed of here—the first by joining the universal condemnation of a deplorable survival, the second by accepting the almost equally universal praise for the undeniable merits of focusing upon the qualities or the significance of the highly select. It is mainly for the lavish display of abundance that a good word still needs to be said, and not merely in apology for something of lesser worth.

What we speak of today as museum exhibition undoubtedly received its start from the collectors' desire to boast of their possessions, often, to be sure, after successful sublimation of this drive into an urge to be of service to science, art, and society. In the beginning, the open shelves and glass fronts in the private homes and the cabinets of the small museums were primarily intended to display the wealth of the personal or institutional collections. There was no thought of separating storage from exhibition. Such an idea would have weakened the primeval purpose of having any display at all.

As the collections grew, it soon became necessary to remove "duplicates" to drawers below the display cases or to storage elsewhere. "Duplicate" is a word used by collectors to describe the second to the millionth specimen of the identical kind. The rule became: only one specimen of each species on display. The duplicates in storage were considered essentially surplus, useful as a reserve for the replacement of primary display specimens or for exchange with other collections, but not serving any independent purpose of their own.

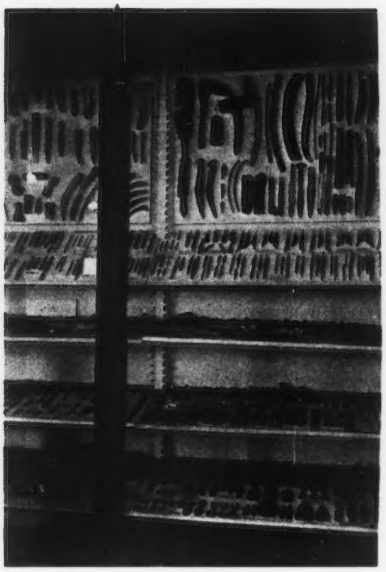

Fig. 1

Fig. 2

But collections continued to grow, and it was not long before even one of a kind became too much. It was not possible to continue to place on exhibit every species of insect or of sea shell, let alone every specimen. A further reduction of display material became unavoidable. Single specimens had to be selected to represent broader categories of more or less similar objects of more than one species or kind.

By this time the tail was wagging the dog. The reserve collection of duplicates had become the research collection of the scientists, many times larger than anything the museum could hope to put on display. Any temptation to use exhibition for ostentatious display of quantity was a thing of the past. Quality became the sole badge of distinction.

Nevertheless, storage displays are still with us in our darker corners, as

Fig. 1. Storage display. The American Museum of Natural History.

Fig. 2. A feast for the browsing eye. Two views. Sassoon ivories. City of Liverpool Public Museums.

Fig. 3. Browsing among the birds. The American Museum of Natural History.

Fig. 4. Hats of other cultures and of western fashions. Temporary "window shopping" exhibit. The American Museum of Natural History.

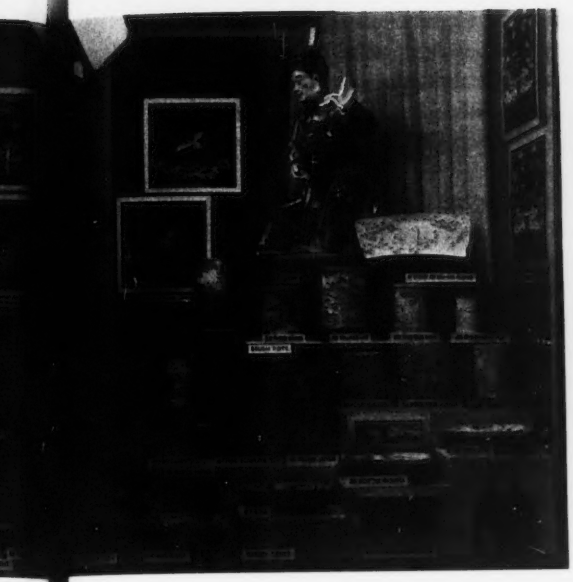

Fig. 3

Fig. 4

living fossils surviving from a primitive past, much as the amoeba is still with us in spite of the emergence of man as the proclaimed victor in the struggle for existence.[1] With a commendable desire to avoid unpleasantness with many esteemed colleagues in other institutions, too numerous to mention, I sadly offer a photograph of one of our own exhibits in evidence of such survival.

While such relics still remain, selection for display, which had started as a housekeeping necessity, has become an end in itself. I would not venture to improve upon the admirable statement of the case for ultra-selection of quality which has been so eloquently presented by Mr. Sweeney in the last issue of this quarterly. I fully agree and particularly wish to endorse the idea of using curatorial choice as a means of offering intellectual leadership even without personal contact with the audience that moves anonymously through our halls. The highly select display is also the type of exhibit in which the art of exhibition is able to find its highest expression, as seen in the beautiful examples illustrating Mr. Sweeney's statement. It would be anticlimactic to attempt to offer other illustrations here. The question I wish to raise is whether the display of choice selections is enough to meet all the educational needs of our museum visitors. In answering that it is not, I am happy to know that I can also claim the agreement of Mr. Sweeney, whose case for ultra-selection is predicated upon the assumption that a wider assortment will always be available for inspection in other rooms or other places to deepen our appreciation and broaden our understanding of the finest, when it is put before us.

"Audience participation" has been the catchword of museum educators for a good many years. Apparently the participation is thought of chiefly in physical terms. Turning a crank or pushing a button is supposed to make the visitor feel party to the events unfolding, or depicted, before him. However that may be, throwing a switch that turns a spotlight on some particular item on display, or starts the locomotive going nowhere on spinning wheels, seems far removed from the true concept of learning by doing. It seems high time to reëstablish that man has brains if he would only use them, and that thinking is doing, too—being, in fact, the principal type of action involved in the development of the mind that should be the aim of all good education. A museum is not a gymnasium, not even for finger exercises with push buttons.

It is sometimes useful to make a statement in the form of a question. Is it the spectator admiring the choice of others, as revealed under the pres-

[1] A situation that ought to bring some relief to this age of anxiety by showing that there is at least one struggle in which the losers do not lose. The casualties seem to be only those who had it coming to them for other reasons and causes. Having created this diversion, we may now return to our topic.

sure of his index finger, who learns by doing, or is it the visitor searching, finding, and passing his own judgment upon what he finds in the plethora of an overabundant display?

This is not an argument against the highly select exhibits. They are the concert halls in which only the finest music is heard. But the music school and the music classroom are necessary, too, and it is not a bad idea to encourage the pupil to whistle his own tunes when it gives him pleasure to do so.

Elimination, selection, and rigorous prefocusing of attention could ultimately banish from all our halls the excitement of personal discovery. Let us therefore not forget to preserve or to reëstablish some wilderness areas among our exhibits, in which our visitors may still have the satisfaction of exploring for themselves, of acquiring truly individual tastes and interests by their own choice, and of developing independent personal judgment through the opportunity to compare good with better and the important with the more important.

When I have often expressed my scorn for the "pawnshop style" of exhibition, it was never with the idea of making a trip to the museum less exciting for the adventurous mind than a visit to a well-assorted pawnshop.

Who's That Knocking on the Door? Opportunity Armed with a Camera

DONALD D. NIBBELINK AND JACK M. STREB
TECHNICAL EDITORS, EASTMAN KODAK COMPANY

A huge, covetous eye is focused on American museums. Its intentions? To spirit away their treasures and share them with thousands of American families. The watchful eye is that of a camera, held figuratively by some thirty-eight million American families. The restless, ever-growing legion of amateur photographers is constantly seeking new pictorial worlds to conquer, and the word is being passed that museums are a relatively uncharted photographic wonderland.

Articles setting the course towards the new happy hunting grounds are being aimed at the amateur photographer. A recently published photographic guide book, "Adventures in Indoor Color Slides," opens a special section on unusual and rewarding photographic subjects in this way: "The museum near your home has more picture material under one roof than any other place we can think of—everything from mummies to muskets. If you have never thought of a museum as a place to take pictures, you've missed some wonderful opportunities. Happily, it's never too late to start." Under the heading "Missing a Good Bet?," a pamphlet sent out to thousands of amateur photographers points out: "Modern museums are a far cry from the dusty mausoleums of yesteryear. Today, they really tell a story in a forceful, dynamic way, using modern display methods with expert layout and superb lighting . . . There is abundant material for your camera in either black-and-white or color." A leading national photography magazine introduced an extensive article on the subject in this way: "Did you know that most important United States museums permit photographers to copy paintings? Here's the exciting story of how you can collect the world's priceless art treasures on film."

These publications are not directed primarily at the professional, who

usually struggles in, by appointment, with his exposure meters and tripods and photofloods. They are aimed at the amateur photographer, a category that includes a large percentage of the population of the United States.

The crucial question is: Amateur photographers are on the verge of discovering museums, but are museums on the verge of discovering amateur photographers? A recent survey of thirteen leading museums points towards an affirmative answer. Although there are a variety of policies governing picture taking in the museums that were polled, the most significant fact is that all allowed picture taking, and eight of the thirteen reported that they "encouraged" photography. Why? Perhaps the reason could be expressed best in the words of William A. Burns, Assistant to the Director of The American Museum of Natural History, who wrote on his questionnaire: "The more people show their pictures, the more their friends will want to see our museum."

In addition to permitting photography, at least two of the responding museums, the Chicago Natural History Museum and the Rochester Museum of Arts and Sciences, occasionally furnish photographic instruction to visitors. The Denver Museum of Natural History supplies visitors with a card of suggested exposures for color.

Special restrictions are imposed by the various museums. Some museums restrict the use of special equipment such as tripods, floodlights, and flash bulbs. Others restrict photography in general to certain days or hours of the week. Loan exhibits are classified as "off limits," and some museums require that the photographer specify exactly what he intends to do with his pictures before granting approval for him to take them.

In almost every case, however, each museum of which inquiry was made expressed interest in obtaining more information on picture taking in museums that might be passed on to camera-bearing visitors. Such information can best be supplied by the museum itself. General ground rules run the grave risk of being more misleading than enlightening, because conditions vary quite widely from museum to museum. But specific tips prepared by the photographic staff of a museum or volunteer advisers render a true service to the amateur photographer. The amateur photographer's basic needs are simple. If he has no specific photographic subject matter in mind when he visits, he would undoubtedly appreciate tips on the most photogenic subjects in the museum. Furthermore, he will certainly be interested in any advice on how to capture those subjects most successfully on film. The extent to which a museum can help him accomplish this goal depends upon the museum itself. If it is interested in having the visitor's pictures used as a visual publicity tool for the museum, it will want to assist him in reproducing its exhibits as faithfully as possible.

Fig. 1. This photographer is trying to capture the carefully conceived mood of the diorama of deer at the Rochester Museum of Arts and Sciences by using indoor film and available light. With this technique, long exposures with a tripod and cable release are a necessity.

Fig. 2. Where is this Indian village? Behind glass in a museum, naturally. Amateur photographers, seeking new worlds to conquer, are taking a long look at pictorial possibilities such as this in the nation's museums. Many directors are becoming increasingly enthusiastic about the publicity that results.

A good place to start is to take a closer look at the man behind the camera. If one does, one will understand, for example, that he is not a disguised anti-intellectual bent on slyly tripping visitors with his tripod, blinding them with his flash bulb, or distracting them with his light meter. Nor will one question the sanity of a wide-eyed visitor who resembles a Persian rug salesman of old as he holds one corner of a large square of black cloth in his teeth, the opposite corner in one hand, and trips a cable release with the remaining hand. Most of these contortions are occasioned by one simple fact. The photographer is trying to reproduce the exhibits in all their beauty. He strives to be not only a recorder but an artist who can recreate the mood established so carefully by the lighting arrangements. To do this properly he must use color film, which raises the question of museum policy on the use of tripods. The use of color film and available light automatically means long exposures with a tripod and a cable release on the camera. If tripods are frowned on in a museum, the photographer will have to use flash, which will "drown out" the display lighting and magnify reflection problems but will produce acceptable pictures. Fast black-and-white film, which requires only a hand-held camera, offers a distinct advantage in many ways, but color in many cases is much more desirable.

The quality of the resulting pictures, of course, will depend not only on the equipment but on the photographer's familiarity with such major considerations as exposure, composition, and depth of field. If the museum does not suggest exposures for its exhibits, a sensitive exposure meter is virtually a necessity for the photographer. A typical exposure time for a diorama, for example, would be thirty seconds at f/8, with the use of an indoor color film such as Kodachrome Film, Type F, or Kodachrome Professional Film, Type A.

The degree to which a museum can and should encourage amateur photographers is, of course, debatable. The present spectrum of cooperation ranges from those museums that go so far as to open glass cases, supply technical information, and turn off adjoining lights to stop glaring reflections, to those that virtually strangle photographic activity with restrictions. This basic difference in photographic policy seems to stem from varying conclusions on how drastically picture-taking visitors interfere with normal museum operations. A careful review of such policies might well be in order at the present time. Carefully controlled experiments might even be undertaken to determine if the benefits incurred from an active encouragement of picture taking would outweigh the disadvantages.

Here are a few ideas which might be considered by a museum in this photographic reëvaluation:

1. Explore the amateur photographer's viewpoint on museum photography. Talk to some of the picture takers in the museum. Find out

which exhibits interest them, what their photographic problems are, and what they do with the pictures they take.

2. For a more advanced photographic outlook, develop a liaison with a camera club in the community. Invite members to look over the museum and offer suggestions on how it can be of help to picture takers.

3. If a museum does not have a photographic staff, enlist the aid of camera-club members to take pictures of key exhibits as an amateur might be expected to take them.

4. A list of suggested exposures for each key exhibit can then be prepared. This information, along with lighting data, can be placed on small cards to be pasted on each exhibit, or it can be included in a one-page leaflet to be handed to visiting photographers.

5. The same or a separate leaflet can include a summary of the photographic regulations of the museum, along with general tips on such items as major pictorial possibilities, how to avoid reflections, and what type of film to use.

The tips naturally will depend on how far the museum is prepared to encourage picture taking. If, after such a reëvaluation as is described, a museum decides that it does not want tripods and flash bulbs on the premises, for example, then the emphasis must be on black-and-white photography, for color film will be virtually useless to the photographer.

It may well be that a museum would wish to experiment before it decided to commit itself on paper. Why not try a photography day or weekend, or a week during which picture-taking activities would be actively encouraged, promoted, and analyzed? Again, camera-club members can be called on for help in planning and executing the test. It is obvious, however, that at some point in the experiment the museum staff must be left on its own to determine the true effect of increased photographic activity on normal museum operations.

The experiment can be as elaborate as a museum wishes to make it and accompanied by almost as much publicity as it wants to give it. That a museum (still considered by many people to be austere and esoteric) had thrown open its doors to the amateur photographers of the community would be appealing to many editors.

At the very least, however, a museum should take just as long and close a look at its prospective picture-taking visitor as he is taking the museum, for he is prepared to take part of the museum home with him to share with his family and friends, if he is permitted to.

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A New Museum Policy

ALEXANDER M. WHITE, PRESIDENT
THE AMERICAN MUSEUM OF NATURAL HISTORY

The American Museum of Natural History has been a pioneer, since its founding, not only in scientific discovery, in educational planning, and in exhibit development, but also in terms of social policy. A review of the history of this ninety-year-old institution would reveal many unprecedented steps that were taken to meet changing needs, which since have become adaptable to the needs of other cultural institutions.

During the last decade science has seen changes greater in both number and implication than took place in the preceding half century. Rarely does a day go by without the announcement of new discoveries, advances in technique, or developments in theory. The frontiers of scientific knowledge are being pushed forward more rapidly than ever before; and the natural history museum, which is both contributor to and interpreter of new knowledge, has not stood still. As a result, the programs of the museum and the responsibilities of those charged with its operation on all levels have changed and broadened.

The director of a natural history museum must have twin attributes. He must have scientific competence of the highest order, and at the same time he must have the ability to handle complex administrative problems. Herein lies a dilemma for the scientist-administrator, as it does for the head of a university. For, as Alfred North Whitehead said: "The combination of imagination and learning requires some leisure, freedom from restraint, freedom from harassing worry, some variety of experiences, and the stimulation of other minds diverse in opinion and diverse in equipment . . . the learned and imaginative life is a way of living and is not an article of commerce."

This leisure and freedom from restraint have become all too infrequent in the life of the museum director who wishes to continue his scientific research. Today, the conflict is more acute than ever before

between the need for scientific knowledge and judgment in administration and the desire of the scientist to pursue his research unhindered. The role of director has become, by the very force of contemporary pressures, one in which the burdens and harassment of the executive function predominate and in which the time spent on research must be eked out. As a result the "learned life" must suffer.

With this conflict in mind, the Board of Trustees of The American Museum of Natural History took a step on April 27, 1959, that represents another historic "first" in the institution's history. The Trustees approved a policy which reflects a new administrative concept and one which should serve the best interest of the Museum, its director, and the public.

Under the terms of this policy a director will be able to return to full-time research as a Senior Scientist of the Museum after fifteen years of administrative service or upon reaching the age of sixty, without sacrifice of income. The resolution of the Board of Trustees states: "It is desirable to have as the director an individual with outstanding qualifications in the field of the natural sciences and the necessary ability to handle the increasing administrative burden of the Museum. To attract the rare few having such qualifications, the term of office should be so limited as to permit the director, without financial sacrifice, to relinquish his administrative burdens for the period prior to his retirement, enabling him to devote himself to his particular educational and scientific interests."

Therefore, from now on a director of the American Museum may have a minimum of at least eight productive years after serving as director in which to do the research he gave up during the term of his executive office. We feel that this new policy will enable the institution to continue to attract as directors men of exceptional abilities who might otherwise hesitate to accept such a position.

PICTURE CREDITS

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